Docket No. SA-537

Exhibit No. 13-A

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Aircraft Performance Group Crash Site Factual Report
(Includes Attachments 1-10)

(250 Pages)

December 6, 2013

Aircraft Performance Crash Site Factual Report

I. ACCIDENT

Description:	Impact with Sea Wall during Final Approach to Runway 28L
Location:	San Francisco International Airport (KSFO), San Francisco, CA
Date:	July 6, 2013
Time:	1128 Pacific Daylight Time (PDT)
Aircraft:	Boeing 777-200ER, HL7742
Operator:	Asiana Airlines
NTSB Number:	DCA13MA120

II. AIRCRAFT PERFORMANCE GROUP

Chairman: Kevin J. Renze, Ph.D.
Vehicle Performance Division, RE-60
National Transportation Safety Board (NTSB)

Members Robert Stoney
Federal Aviation Administration (FAA) Test Pilot
Seattle Aircraft Certification Office (ACO)

Jae Soo Kim (On-scene, now retired from ARAIB)
Senior Investigator
Aviation and Railway Accident Investigation Board (ARAIB)
Republic of Korea

Dae Young Lee* (Replacement for Jae Soo Kim)
Investigator
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1.0 INTRODUCTION

On July 6, 2013 at 1128 am local time, a Boeing 777-200ER, registration HL7742, operated by Asiana Airlines as flight 214, struck the seawall short of runway 28L at San Francisco International Airport. The airplane was destroyed by impact forces and fire. Three of the 291 passengers were fatally injured. The flight was a regularly scheduled passenger flight from Incheon International Airport, Seoul, Korea, and was operated under the provisions of 14 *Code of Federal Regulations* Part 129. Visual meteorological conditions prevailed at the time of the accident.

*Group member was unavailable for on-scene activities.

The on-scene aircraft performance investigative activities commenced on the morning of July 7, 2013 with NTSB and FAA representatives. The ARAIB on-scene group member was added on July 8, 2013. The aircraft performance group members from The Boeing Company and Asiana Airlines were not available for on-scene activities

2.0 FACTUAL EVIDENCE

The factual evidence collected by the aircraft performance group is described in this section.

2.1 Boeing 777-200 Three-View Drawing and General Specifications

A simplified three-view drawing for the Boeing 777-200 and general specifications are provided in Attachment 1.

2.2 Airport, Runway, and Approach Information

A general airport overview diagram for KSFO and detailed runway 28L characteristics are included in Attachment 2. Runway 28L is grooved and was reported to be bare and dry at the time of the accident. The most recent flight inspection report for the Precision Approach Path Indicator (PAPI) on runway 28L, the post-accident Localizer flight inspection report, and the approach charts are also available in Attachment 2.

A Notice to Airmen (NOTAM) indicated that the precision approach Instrument Landing System (ILS) glide path for runway 28L was out of service since June 1, 2013.

2.3 Weather

The NTSB Meteorological Specialist provided the following Aviation Routine Weather Report (METAR) information:

```
SA       06/07/2013 18:56->
METAR KSFO 061856Z 21007KT 170V240 10SM FEW016 18/10 A2982
           RMK AO2 SLP098 T01830100=

SA       06/07/2013 17:56->
METAR KSFO 061756Z 21006KT 10SM FEW016 18/10 A2982 RMK AO2
           SLP097 T01780100 10183 20128 51005=
```

Weather at 1856 UTC or 1156 PDT wind from 210 degrees at 7 knots, wind variable from 170 degrees through 240 degrees, 10 miles visibility, few clouds at 1,600 feet agl, temperature 18 Celsius, dew point temperature 10 Celsius, altimeter 29.82 in Hg. Remarks: sea level pressure 1009.8 hPa, temperature 18.3 Celsius, dew point temperature 10.0 Celsius.

Weather at 1756 UTC or 1056 PDT wind from 210 degrees at 6 knots, 10 miles visibility, few clouds at 1,600 feet agl, temperature 18 Celsius, dew point temperature 10 Celsius, altimeter 29.82 in Hg. Remarks: sea level pressure 1009.7 hPa, temperature 17.8 Celsius, dew point temperature 10.0 Celsius.

Terminal Aerodrome Forecast (TAF):

```
T        06/07/2013 17:58->
TAF AMD KSFO 061758Z 0618/0724 VRB04KT P6SM FEW012 FM061900 29012KT
          P6SM FEW012 FM070700 26005KT P6SM BKN007 FM071600 23004KT
          P6SM FEW010 FM072000 29012KT P6SM FEW015=
```

TAF at 1058 PDT (1758 UTC) wind variable at 4 knots, visibility 6 miles or greater, few clouds at 1,200 feet agl.

```
FT       06/07/2013 17:30->
TAF KSFO 061730Z 0618/0724 VRB04KT P6SM FEW012 FM061900 29012KT
          P6SM FEW012 FM070700 27006KT P6SM FEW012 FM070900 26005KT
          P6SM BKN007 FM071600 23004KT P6SM FEW010 FM072000 29012KT
          P6SM FEW015=
```

TAF at 1730 UTC or 1030 PDT wind variable at 4 knots, visibility 6 miles or greater, few clouds at 1,200 feet agl.

2.4 Asiana Flight 214 Records

The flight dispatch release, load sheet, fuel upload receipt, maintenance record establishing the airplane Basic Empty Weight (B.E.W.), and the Aircraft Communications Addressing and Reporting System (ACARS) messages collected on-scene are provided in Attachment 3.

2.5 Accident Site Survey

Evidence from the accident site was documented on July 7-10, 2013. Evidence Recovery Team (ERT) specialists from the Federal Bureau of Investigation (FBI) used two Total Station units to survey the approach end of runway 28L, the displaced threshold region, and about the first 2,000 feet of runway 28L from the arrival threshold, including the adjacent runway shoulders and infield areas. Members of the NTSB Structures, Survival Factors, Systems, Propulsion, and Aircraft Performance Groups identified significant witness marks, airplane structure and interior components, and airplane wing and fuselage wreckage that were included in the survey.

2.5.1 Witness Marks and Airplane Evidence

Witness marks were documented by means of sketches, photographs, tape measurements, FBI ERT Total Station survey teams, and handheld GPS measurements.[1] Witness marks and airplane damage evidence included sea wall stone displacement; ground scars, scrapes, and gouges; rubber deposits; empennage separation into vertical tail, left and right horizontal tail, and tail cone components; a dense airplane aft fuselage debris path; left and right main landing gear strut separation, including truck axle and main gear wheel separations; left and right nose wheel separation; number one engine separation, including fracture of all 22 fan blades; left nose wheel tire rutting in soil; damage to three of the four runway 28L PAPI units closest to the runway 28L centerline; damage to the airplane leading and trailing edge devices, right wing, left and right wing tips, and engine strut and nacelle damage. Results of the survey are documented in Attachment 4.

[1] Handheld GPS data were collected with a Garmin Oregon 450 GPS device.

2.5.2 Photographic Evidence

The airplane ground track and witness mark evidence is documented in part by the accident site aerial photograph and the photograph log in Attachment 4. Figure 1 shows that the vertical stabilizer, left and right horizontal stabilizer, and the left and right main landing gear struts, trucks, and wheels departed the aircraft prior to the runway 28L threshold. Figure 2 records the aircraft fuselage position in the left-hand infield grass region just downrange of the damaged runway 28L PAPI equipment, setback from the left shoulder of runway 28L.

Figure 1: View of airplane wreckage components looking toward sea wall from the runway 28L numbers. Left and right horizontal stabilizers (left), vertical stabilizer (right), and left and right main landing gear components (struts, trucks, and wheels) are visible.

Figure 2: View of airplane fuselage and right wing looking toward damaged runway 28L PAPI installation from sea wall side.

2.6 Video Study

Video footage from two KSFO airport security video surveillance cameras (of eight videos collected from various sources) that recorded portions of the accident flight was used to compose a story-board to pictorially summarize events during the Asiana flight 214 landing. The images in Figures 3–8 were extracted from video footage recorded by camera C5106. Similarly, the images in Figure 9 were extracted from video footage recorded by camera C225, mounted on the control tower roof.

Figure 3: KSFO airport security camera “P WTR TXWY L M W C5106” at video time 11:27:41.

Aircraft on right is Asiana 214, approaching KSFO runway 28L; aircraft on left is moving from left to right along Taxiway “F” and is believed to be United flight 885.

Figure 4: KSFO airport security camera “P WTR TXWY L M W C5106” at video time 11:27:46.

At this point in the video there is a perceptible increase in pitch attitude.

Figure 5: KSFO airport security camera “P WTR TXWY L M W C5106” at video time 11:27:49.

Approximate time of impact of Asiana 214.

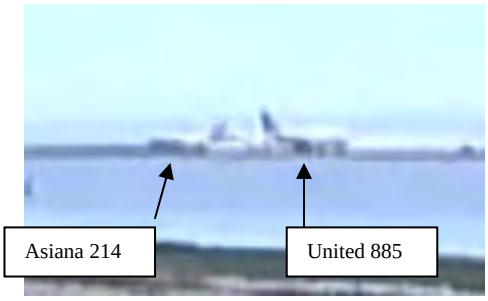


Figure 6: KSFO airport Security Camera “P WTR TXWY L M W C5106” at video time 11:27:51.

At this time, the aircraft is observed to be sliding along the ground and the vertical stabilizer and rudder are observed to depart the aircraft fuselage. United 885 is now visually to the right of Asiana 214 in the video scene.

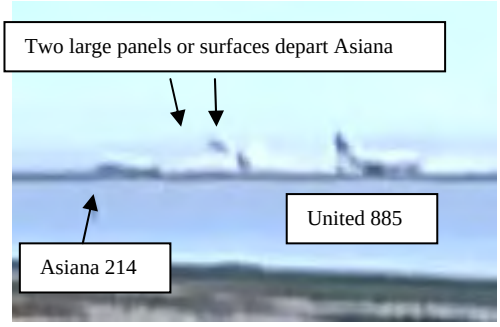


Figure 7: KSFO airport security camera “P WTR TXWY L M W C5106” at video time 11:27:53.

Two large panels or surfaces are observed flying through the air, detached from and behind Asiana 214. The panels/ surfaces disappear into a cloud of dust or smoke behind the aircraft at about 11:27:56.

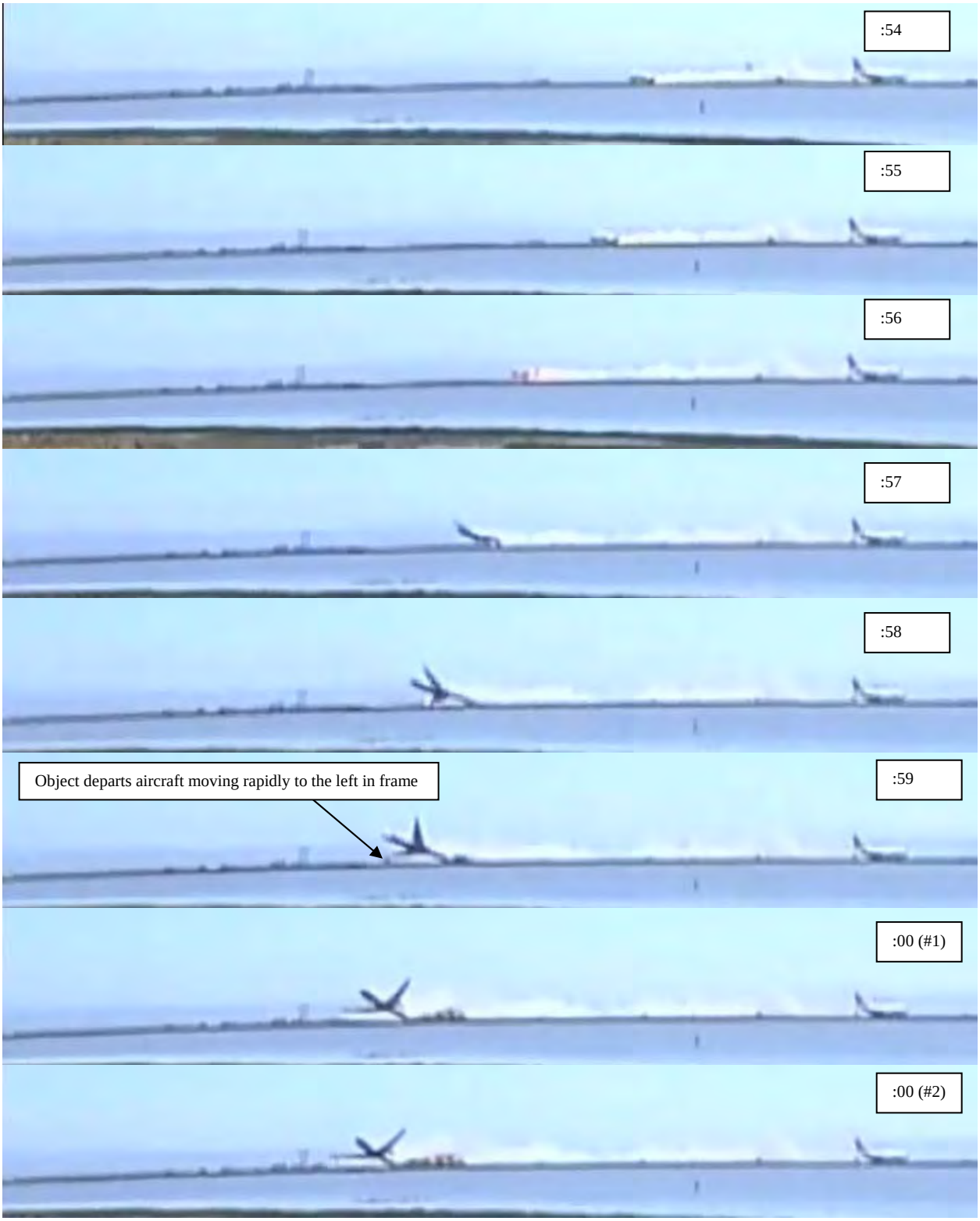


Figure 8: KSFO airport security camera “P WTR TXWY L M W C5106” from about video time 11:27:54 through about 11:28:00.

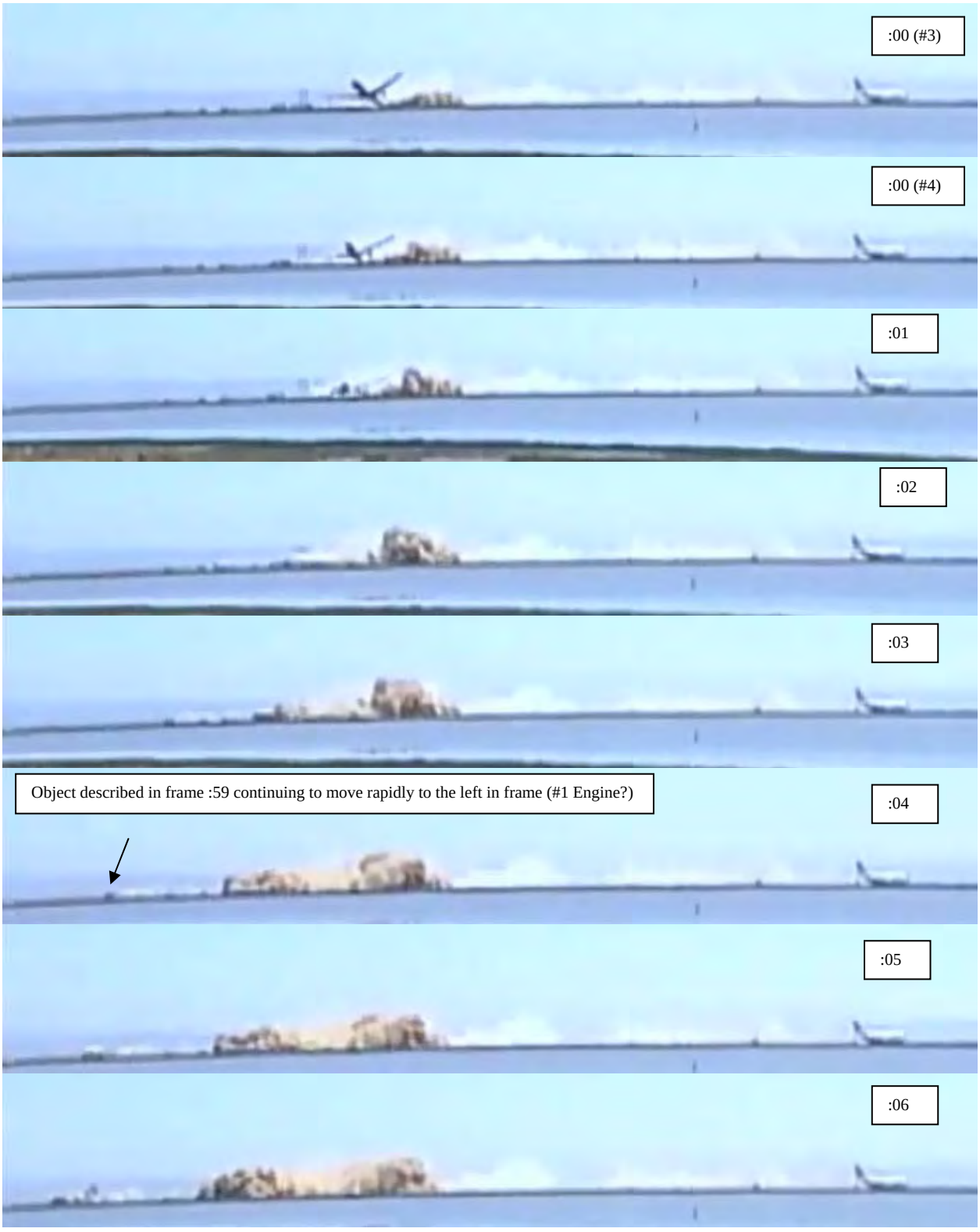


Figure 8 (continued): KSFO airport security camera “P WTR TXWY L M W C5106” from about video time 11:28:00 through about 11:28:06.

Figure 8 (continued): KSFO airport security camera “P WTR TXWY L M W C5106” from about video time 11:28:14 through about 11:28:32.

11:27:34

Asiana 214 first appears on this camera

11:27:41

About 1/2 way down pier with lead-in lights

11:27:49

Approximate time of impact

11:27:54

5 seconds later

11:27:59

5 secs later; object leaving left wing

11:28:04

5 secs later; object traveling rapidly

11:28:19

15 secs later; aircraft is stopped

Figure 9: KSFO airport security camera “T2 ROOF TOWER 2 C225” Asiana flight 214; Series of photos prior to and after impact from about 11:27:34 to about 11:28:19.

2.7 Aircraft Arrivals Prior to Asiana Flight 214 (AAR214)

The NTSB Air Traffic Control (ATC) specialist provided the following history of flight arrivals on runways 28L and 28R for the approximately 30-minute period prior to Asiana Airlines flight 214 on July 6, 2013.

Call Sign	Airplane	Runway	UTC/GMT
ACA737	A320	28R	1755
AAL431	B763	28L	1756
UAL892	B744	28R	1756
SKW5366	E120	28L	1759
SKW5395	E120	28R	1759
AAL303	B737	28R	1802
SKW5492	CRJ1	CRJ2	1804 [2]
DAL2305	B762	28R	1806
UAL1290	B737	28L	1808
SWA2030	B737	28L	1811
SKW4804	CRJ9	28L	1813
UAL759	A319	28R	1813
UAL752	B777	28L	1815
UAL568	B758	28R	1816
UAL570	B763	28L	1817
UAL397	B752	28R	1818
UAL697	A320	28R	1819
UAL870	B744	28L	1820
ACA761	A310	28R	1821
UAL694	B752	28R	1824
ANA8	B777	28L	1825
SKW6263	E120	28L	1827
AAR214	B777	28L	1828

2.8 FAA Air Traffic Control (ATC) Radar and ADS-B Data

The NTSB Air Traffic Control Specialist collected the available Airport Surveillance Radar (ASR) data and the Automatic Dependent Surveillance-Broadcast (ADS-B) data for Asiana flight 214. These data are documented in the ATC Work Group Chairman's Factual Report.

2.9 Flight Data Recorder (FDR) and Quick Access Recorder (QAR) Data

The NTSB FDR Group transcribed the raw binary data to engineering units for a subset of the parameters available on the Asiana flight 214 FDR and QAR, respectively, as described in the Flight Data Recorder Group Chairman's Factual Report. Plots of 231 FDR parameters validated by the FDR Group are included in Attachment 5 as a function of FDR subframe reference number (elapsed seconds) for two time periods, the final 100 seconds and the descent from about 11,000 feet, respectively.

[2] Table entry appears to be incomplete or incorrect.

2.10 Cockpit Voice Recorder (CVR) Data

The accident flight transcript is documented in the Cockpit Voice Recorder Group Chairman's Factual Report. The CVR transcript should be available on the NTSB public docket on December 10, 2013.

2.11 Precision Approach Path Indicator (PAPI) for KSFO Runway 28L[3]

The KSFO runway 28L Instrument Landing System (ILS) glideslope signal was inoperative at the time of the accident (per NOTAM). However, visual vertical flight path guidance to the runway was available from the PAPI lighting system on runway 28L. The FAA *Aeronautical Information Manual* (AIM) describes the PAPI system as follows:

> **Precision Approach Path Indicator (PAPI).** The precision approach path indicator (PAPI) uses light units … installed in a single row of either two or four light units. These lights are visible from about 5 miles during the day and up to 20 miles at night. The visual glide path of the PAPI typically provides safe obstruction clearance within plus or minus 10 degrees of the extended runway centerline and to 4 SM from the runway threshold. Descent, using the PAPI, should not be initiated until the aircraft is visually aligned with the runway. The row of light units is normally installed on the left side of the runway and the glide path indications are as depicted [in Figure 10]. Lateral course guidance is provided by the runway or runway lights. In certain circumstances, the safe obstruction clearance area may be reduced due to local limitations, or the PAPI may be offset from the extended runway centerline. This will be noted in the Airport/ Facility Directory (AIM paragraph 2-1-2 (b)).

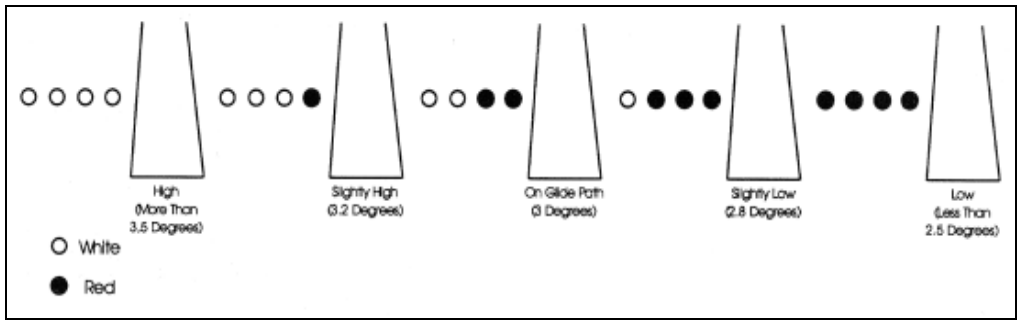


Figure 10: PAPI presentation (AIM Figure 2-1-5).

Technical specifications for the design of the PAPI system, including the flight path angle ranges corresponding to each combination of light displays, are contained in FAA Advisory Circular (AC) 150/5340-30G, *Design and Installation Details for Airport Visual Aids*. Section 7.5(d) of this AC addresses the design of the PAPI, and Table 7-2 of the AC (Figure 11 below) describes the aiming of Type L-880 (4 Box) PAPI relative to the pre-selected flight path angle:

[3] Content in this section was provided by John J. O'Callaghan, the NTSB National Resource Specialist for Aircraft Performance, working remotely to support on-scene investigative activities.

Table 7-2. Aiming of Type L-880 (4 Box) PAPI Relative to Pre-selected Glide Path.

Light Unit	Aiming Angle (in minutes of arc)	Height group 4 aircraft on runway with ILS
	Standard installation	
Unit nearest runway	30' above glide path	35' above glide path
Next adjacent unit	10' above glide path	15' above glide path
Next adjacent unit	10' below glide path	15' below glide path
Next adjacent Unit	30' below glide path	35' below glide path

Figure 11: Table 7-2 from AC 150/5340-30G.

"Height group 4 aircraft" are described in Table 7-1 of AC 150/5340-30G, shown below in Figure 12.

Table 7-1. Threshold Crossing Heights.

Representative aircraft. Type	Approximate Cockpit-to-wheel height	Visual Threshold Crossing Height	Remarks
Height Group 1 General aviation Small commuters Corporate turbo jets	10 ft. (3 m) or less	40 ft. (+5, -20) 12 m (+2, -6)	Many runways less than 6,000 ft. (1829 m) long with reduced widths and/or restricted weight bearing that would normally prohibit landings by larger aircraft.
Height Group 2 F-28, CV-340/44O/580 B-737, DC-9, DC-8	15 ft. (4.5 m)	45 ft. (+5, -20) 14 m (+2, -6)	Regional airport with limited air carrier service
Height Group 3 B-727/707/720/757	20 ft. (6 m)	50 ft. (+5,-15) 15 m (+2, -6)	Primary runways not normally used by aircraft with ILS glide-path-to-wheel heights exceeding 20 ft. (6 m).
Height group 4 B-747/767, L-1011, DC-10 A-300	Over 25 ft. (7.6 m)	75 ft. (+5, -15) 23 m (+2, -4)	Most primary runways at major airports.

Figure 12: Table 7-1 from AC 150/5340-30G.

Height group 4 best describes runway 28L at KSFO, which is a primary runway at a major airport, and is served by an ILS. Furthermore, prior to a recent change to the PAPI system, the threshold crossing height (TCH) of the PAPI for runway 28L was 75 feet, corresponding to height group 4. The change to the PAPI system lowered the TCH to 63.8 ft.

The TCH values, touchdown reference point, and pre-selected glide path angle for the runway 28L PAPI system both before and after the recent change are specified in the FAA online database of airport and navigation aid information at http://avnwww.jccbi.gov/datasheet/. The data for the PAPI before the change are provided in the "A" (for "Active") version of the data sheet for KSFO runway 28L, and the data for PAPI after the change are provided in the "P" (for "Pending") version of the data sheet. The PAPI information in the two versions is shown in Table 1:

Table 1: PAPI information in "A" and "P" versions of FAA datasheet for KSFO runway 28L.

Item		**A ("Active") datasheet**	**P ("Pending") datasheet**
Glide path angle		3.00°	2.85°
Threshold Crossing Height (TCH)		75 ft.	63.8
Reference point	latitude	N 37° 36' 48.8300"	N 37° 36' 49.8400"
	longitude	W 122° 21' 45.9500"	W 122° 21' 48.3700"
	elevation	9.4 ft.	8.4
Distance from runway threshold to reference point		1448.0 ft.	1366.5 ft.
Runway threshold	latitude	N 37° 36' 42.1529"	N 37° 36' 42.1529"
	longitude	W 122° 21' 30.0312"	W 122° 21' 30.0312"
	elevation	12.7 ft.	12.7 ft.
Displaced threshold	latitude	N/A	N 37° 36' 43.5437"
	longitude	N/A	W 122° 21' 33.3539"
	elevation	N/A	12.6 ft.

In addition to the PAPI changes noted in Table 1, recent changes to the KSFO runway 28L configuration included the addition of a displaced threshold. The "Distance from runway threshold to reference point" specified in Table 1 is from the original runway threshold in the "A" datasheet, but from the displaced threshold in the "P" datasheet. The coordinates of the original and displaced thresholds are listed in Table 1.

The "P" values for the PAPI specified in Table 1 represent the intended configuration of the system. The actual configuration may differ, and the configuration of the PAPI could not be verified because it was damaged by the accident airplane. In order to ensure that the actual configuration matches the intended configuration within specified tolerances, the FAA conducts flight inspections of PAPI and ILS systems. An FAA Flight Inspection Report on the PAPI for KSFO runway 28L dated 07/02/2013 (4 days before the accident, included in Attachment 2) contains the following information in the "Remarks" section:

> S-08-154-12 reconfiguration of PAPI to runway 28L. Run 1: Box 2=3.18, Box 3=2.81 Angle=3.0. Run 2: Box 2=3.14, Box 3=2.78 Angle 2.96. Final=2.98. * ILS SIAP and RNAV SIAP both marked not coincident due to TCH. *Electronic Glideslope OTS at time of inspection.

A box labeled "G.S. Angle," contains the entry "2.85/2.98 Sat." Per a discussion with a flight inspection expert at the FAA, this means that the intended glide slope (path) angle is 2.85°, the as-inspected glide path angle is 2.98°, and that since this result is within the required tolerance of 0.2°, it is satisfactory.

Interestingly, the angular difference between Box 2 (second light from right in the PAPI display) and the glide path centerline is 3.18° - 3.0° = 0.18° = 10.8 minutes of arc for Run1, and 3.14° - 2.96° = 0.18° for Run2. The angular difference between Box 3 (third light from

right in the PAPI display) and the glidepath centerline is 2.81° - 3.0° = -0.19° = -11.4 minutes of arc for Run 1, and 2.78° - 2.96° = -0.18° for Run 2. Hence, the flight-inspected PAPI beam widths, for the inner light boxes at least, appear to match the "Standard Installation" specified in Figure 11 better than the "height group 4" installation. However, since the tolerance on the angles is 0.2° (12 minutes of arc) and the difference between the standard and "height group 4" angles for Box 2 and Box 3 is only 5 minutes of arc, either installation will be within the tolerances of the other.

The PAPI display to the accident airplane was calculated as the airplane approached runway 28L. This problem equates to knowing the position of the airplane relative to each of the four PAPI light beams. The angle of these beams relative to the runway is defined by the (actual) PAPI glide path angle, and the (actual) aiming angles of each of the beams relative to the glide path angle.

PAPI beam solutions for both the design value of the PAPI glide path angle (2.85°), and the flight-inspected value of the PAPI glide path angle (2.98°), are included in the Google Earth file (DCA13MA120_PAPI_PEND_FLIGHT_INSPECTED_STANDARD_GROUP4.kmz). In the .kmz file data, the aiming angle of each of the PAPI beams relative to the glide path angle is assumed to be as specified in Table 2. Solutions for both the "standard" and "height group 4" aiming specifications are included.

Table 2: Index to PAPI solutions contained in *Google Earth* .kmz file. In the notes column, "W" represents a white light, and "R" represents a red light in the PAPI display.

Object name	Glide path angle (deg.)	Deviation from glide path angle (minutes of arc)	Notes
PAPI_P-WWRR		0	Glide path centerline
PAPI_P-RRRR		-30	Boundary between RRRR & WRRR
PAPI_P-WRRR	2.85°	-10	Boundary between WRRR & WWRR
PAPI_P-WWWR		+10	Boundary between WWRR & WWWR
PAPI_P-WWWW		+30	Boundary between WWWR & WWWW
PAPI_P_G4-WWRR		0	Glide path centerline
PAPI_P_G4-RRRR		-35	Boundary between RRRR & WRRR
PAPI_P_G4-WRRR	2.85°	-15	Boundary between WRRR & WWRR
PAPI_P_G4-WWWR		+15	Boundary between WWRR & WWWR
PAPI_P_G4-WWWW		+35	Boundary between WWWR & WWWW
PAPI_FI-WWRR		0	Glide path centerline
PAPI_FI-RRRR		-30	Boundary between RRRR & WRRR
PAPI_FI-WRRR	2.98°	-10	Boundary between WRRR & WWRR
PAPI_FI-WWWR		+10	Boundary between WWRR & WWWR
PAPI_FI-WWWW		+30	Boundary between WWWR & WWWW
PAPI_FI_G4-WWRR		0	Glide path centerline
PAPI_FI_G4-RRRR		-35	Boundary between RRRR & WRRR
PAPI_FI_G4-WRRR	2.98°	-15	Boundary between WRRR & WWRR
PAPI_FI_G4-WWWR		+15	Boundary between WWRR & WWWR
PAPI_FI_G4-WWWW		+35	Boundary between WWWR & WWWW

The calculated PAPI display results are compared to the accident flight path defined by the FAA ATC ASR-9 radar data on pages 15–18 in the following order: PAPI_P (Standard, Pending), PAPI_FI (Standard, Flight Inspected), PAPI_P_G4 (Group 4, Pending), PAPI_FI_G4 (Group 4, Flight Inspected).

Note: The projected lines representing calculated PAPI beam guidance are not visible to flight crewmembers. Flight crewmembers view the PAPI lights, which are only visible from a finite distance that may vary with atmospheric conditions and time of day.

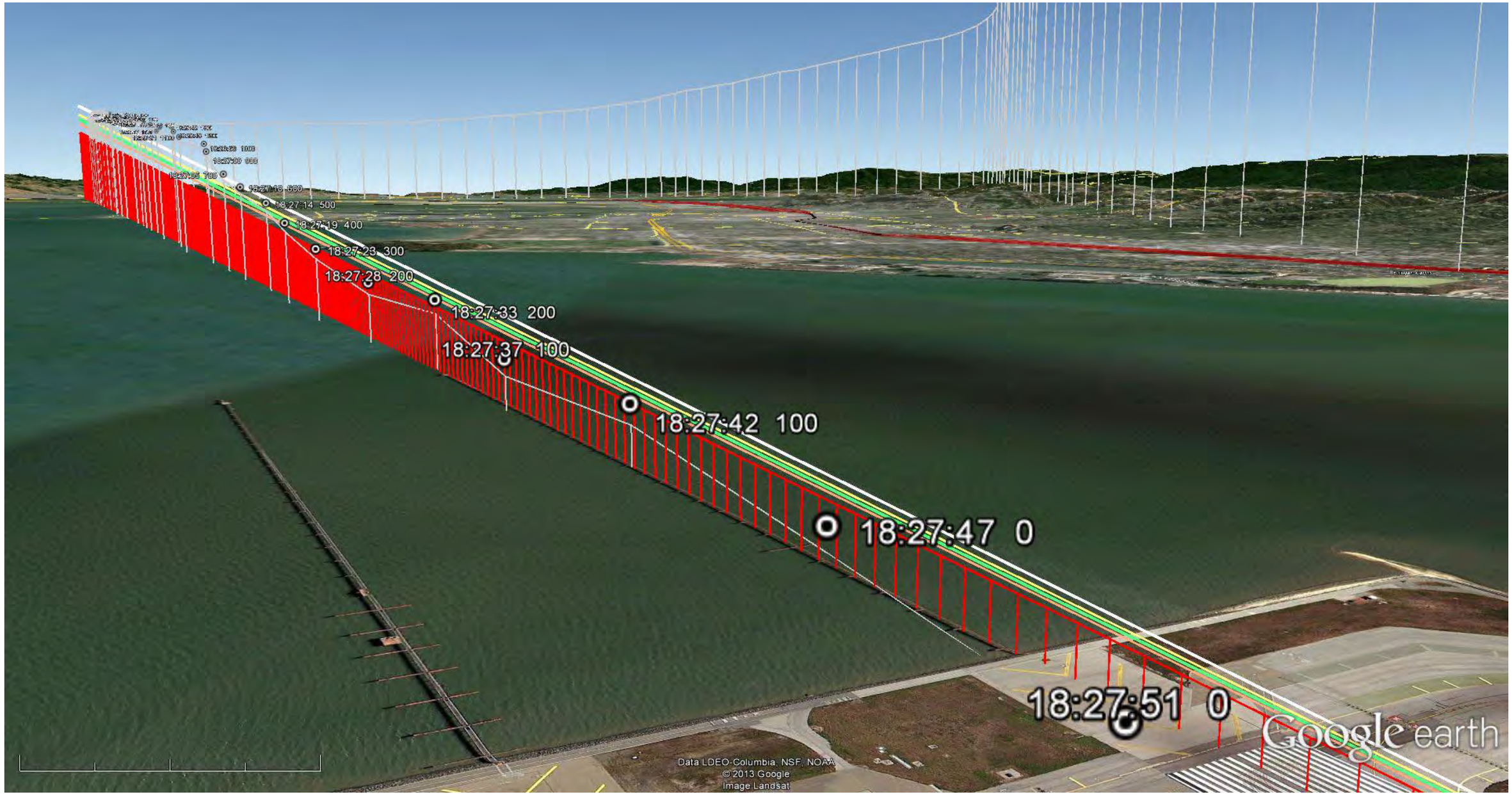


Figure 13: Comparison of calculated PAPI (STANDARD, PENDING) guidance to FAA ASR-9 radar data (gray line, white symbols) for Asiana Airlines flight 214. On glideslope is defined by the green line, bounded by the region between the orange line and the yellow line. Region above white line is PAPI-WWWW; region between white line and yellow line is PAPI-WWWR; region between orange line and red line is PAPI-WRRR; region below red line corresponds to PAPI-RRRR.

Note: The projected lines representing calculated PAPI beam guidance are not visible to flight crewmembers. Flight crewmembers view the PAPI lights, which are only visible from a finite distance that may vary with atmospheric conditions and time of day.

Figure 14: Comparison of calculated PAPI (STANDARD, FLIGHT INSPECTED) guidance to FAA ASR-9 radar data (gray line, white symbols) for Asiana Airlines flight 214. On glideslope is defined by the green line, bounded by the region between the orange line and the yellow line. Region above white line is PAPI-WWWW; region between white line and yellow line is PAPI-WWWR; region between orange line and red line is PAPI-WRRR; region below red line corresponds to PAPI-RRRR.

Note: The projected lines representing calculated PAPI beam guidance are not visible to flight crewmembers. Flight crewmembers view the PAPI lights, which are only visible from a finite distance that may vary with atmospheric conditions and time of day.

Figure 15: Comparison of calculated PAPI (GROUP 4, PENDING) guidance to FAA ASR-9 radar data (gray line, white symbols) for Asiana Airlines flight 214. On glideslope is defined by the green line, bounded by the region between the orange line and the yellow line. Region above white line is PAPI-WWWW; region between white line and yellow line is PAPI-WWWR; region between orange line and red line is PAPI-WRRR; region below red line corresponds to PAPI-RRRR.

Note: The projected lines representing calculated PAPI beam guidance are not visible to flight crewmembers. Flight crewmembers view the PAPI lights, which are only visible from a finite distance that may vary with atmospheric conditions and time of day.

Figure 16: Comparison of calculated PAPI (GROUP 4, FLIGHT INSPECTED) guidance to FAA ASR-9 radar data (gray line, white symbols) for Asiana Airlines flight 214. On glideslope is defined by the green line, bounded by the region between the orange line and the yellow line. Region above white line is PAPI-WWWW; region between white line and yellow line is PAPI-WWWR; region between orange line and red line is PAPI-WRRR; region below red line corresponds to PAPI-RRRR.

2.12 FAA Air Traffic Control Transcripts (TRACON and Tower)

The FAA Air Traffic Control Transcripts for the applicable Terminal Radar Approach Control Facility (TRACON) and KSFO Tower controller positions are available in Attachment 6.

2.13 B777 Elevator, Aileron, and Flaperon System Description

Excerpts of the Boeing 777 Airplane Maintenance Manual (AMM) descriptions of the elevator system and the aileron and flaperon system are included in Attachments 7 and 8, respectively.

2.14 Related Asiana Airlines Guidance and Procedures

Excerpts of the Asiana Airlines Flight Operations Manual (FOM) and the Asiana Airlines Pilot Operations Manual (POM) guidance are available in Attachment 9 for items including the approach and landing checklists, visual approach procedures, normal landing procedures, stabilized approach criteria, missed approach and go-around procedures, and weight and balance procedures.

2.15 Related Boeing Guidance and Procedures

A subset of the airframe manufacturer guidance that documents the B777 landing checklist, stabilized approach criteria, and minimum maneuver speed is provided in Attachment 10.

2.16 Sequence of Asiana Flight 214 Events

A draft chronological summary of Asiana flight 214 events is provided on pages 23–26 based on available FDR, CVR, ATC Transcript, and video surveillance camera evidence during the on-scene portion of the investigation.

2.17 Surveillance Video Camera Data

The security camera locations and approximate field of view for SFO Security Operations Center cameras C824, C825, and C5106 are shown in Figures 17–19, respectively. Camera 225 is a PTZ camera (can remotely control camera pan, tilt, and zoom) mounted on the control tower rooftop. Each of these video surveillance cameras recorded some portion of the airplane flight path or ground track.

Table 3: SFO Security Operations Center Camera Position (NAD83 California State Planes, Zone III, U.S. Foot Format)

Camera	Field of View Capability	X	Y	Approx. Height, feet AGL
225	Pan-Tilt-Zoom	6016201.25	2052620.97	190
824	Fixed	6011180.50	2056796.81	57
825	Fixed	6011183.46	2056728.17	57
5106	Fixed	6018019.40	2049386.05	14

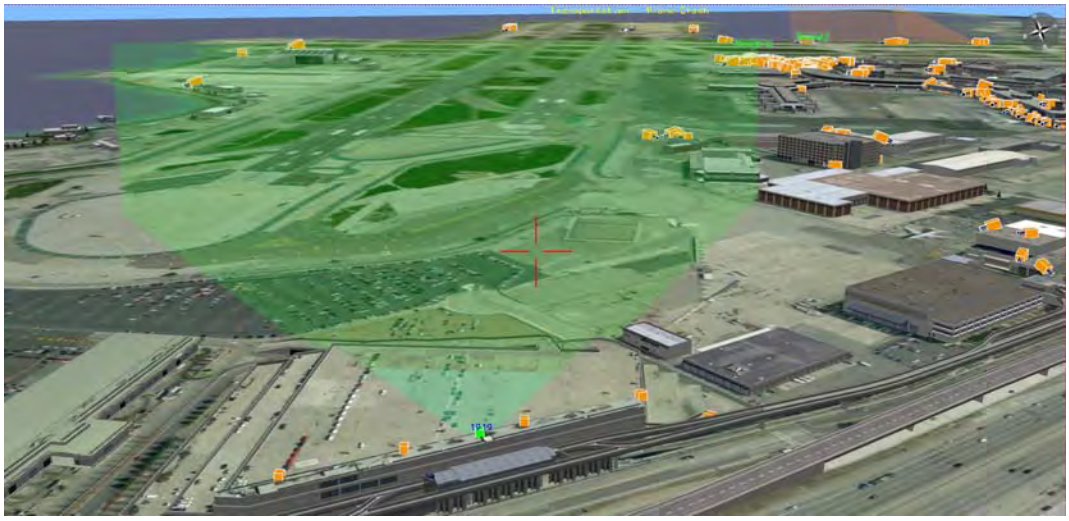


Figure 17: SFO Security Operations Center camera C824 approximate position (green square in center foreground) and field of view (green shaded volume).

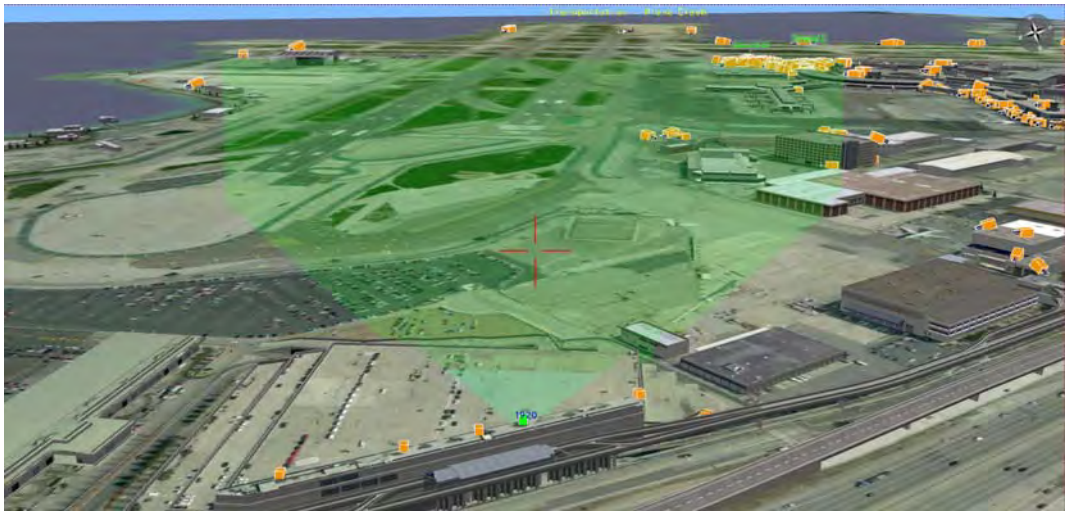


Figure 18: SFO Security Operations Center camera C825 approximate position (green square in center foreground) and field of view (green shaded volume).

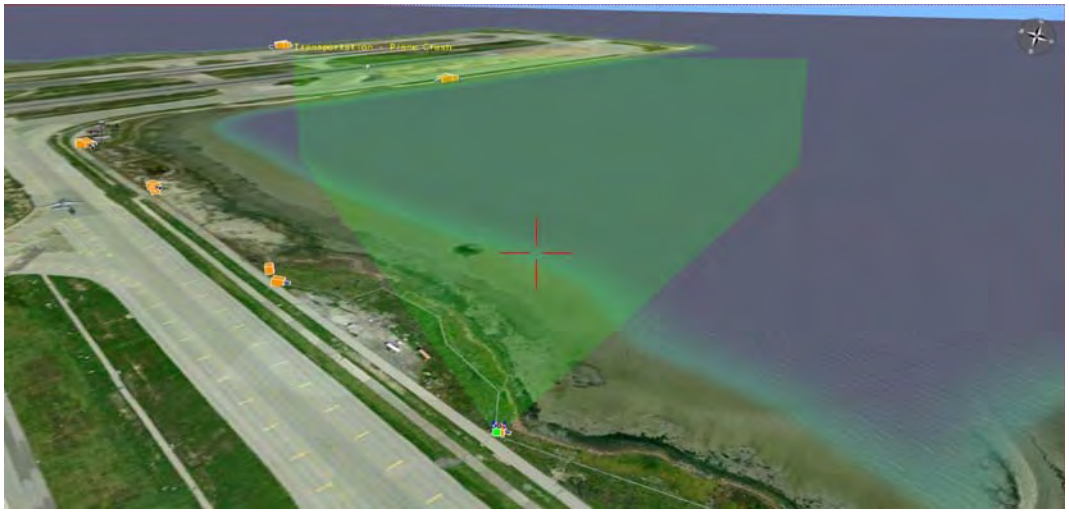


Figure 19: SFO Security Operations Center camera C5106 approximate position (green square in center foreground) and field of view (green shaded volume).

The approximate locations and lines of site for the video surveillance cameras that recorded the approach of Asiana flight 214 (Bayshore Highway camera) and post-accident events (United Airlines maintenance hangar camera) are shown in Figures 20 and 21, respectively.

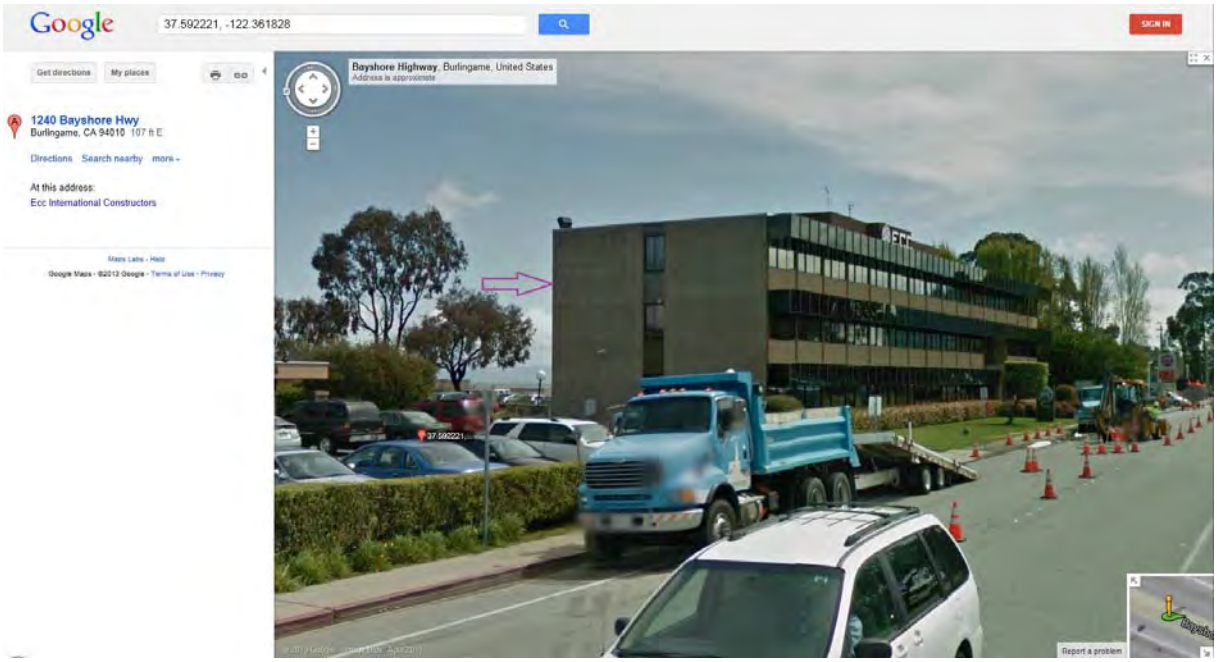


Figure 20: Approximate location of the Bayshore Highway video surveillance camera that recorded the Asiana flight 214 approach.

Figure 21: Approximate location of the United Airlines maintenance hangar video surveillance camera that recorded post-accident events.

Additional video surveillance camera footage that captured portions of the airplane flight path or ground track was provided from various sources to the NTSB investigation and is identified

by the following prefixes:

Gate 55 (side of Gate 55; "Intransa" video system; "Milestone" software)

PTZ 54 (Virgin Atlantic; pan-tilt-zoom capability)

Camera 6 (middle of Superbay Hangar, west side; from a "home quality" VCR system)

CNN Hayes (posted on YouTube)

BurCA (1420 Bayshore Highway; prefix BurCa2 for flight 214, BurCa1 for prior arrival)

Time-sequenced images from each camera that documented a portion of the Asiana flight 214 flight path and/or ground track are provided in Attachments 11–19. Image content may have been cropped to focus on factual evidence related to Asiana flight 214, but the original image aspect ratio has been preserved. Extracted images from prior aircraft arrivals are provided in Attachments 20 and 21 from the BurCA and KSFO C5106 surveillance cameras, respectively.

3.0 ATTACHMENTS

Attachment 1: B777-200 Three-View Drawing and General Specifications

Attachment 2: KSFO Airport, Runway, and Approach Information

Attachment 3: Asiana Airlines Flight 214 Records

Attachment 4: Accident Site Survey and Photograph Log

Attachment 5: Flight Data Recorder (FDR) Data

Attachment 6: FAA ATC Transcripts (TRACON and Tower)

Attachment 7: Elevator System Description

Attachment 8: Aileron and Flaperon System Description

Attachment 9: Related Asiana Airlines Guidance and Procedures

Attachment 10: Related Boeing Guidance and Procedures

Attachment 11: Video Surveillance Camera Image Sequence from KSFO C5106

Attachment 12: Video Surveillance Camera Image Sequence from KSFO C225

Attachment 13: Video Surveillance Camera Image Sequence from KSFO C824

Attachment 14: Video Surveillance Camera Image Sequence from KSFO C825

Attachment 15: Video Surveillance Camera Image Sequence from Gate 55

Attachment 16: Video Surveillance Camera Image Sequence from PTZ 54

Attachment 17: Video Surveillance Camera Image Sequence from Camera 6

Attachment 18: Video Surveillance Camera Image Sequence from CNN Hayes

Attachment 19: Video Surveillance Camera Image Sequence from BurCA2,
(Asiana flight 214 arrival)

Attachment 20: Video Surveillance Camera Image Sequence from BurCA1
(Comparable aircraft prior arrival)

Attachment 21: Video Surveillance Camera Image Comparison from KSFO C5106,
(Pre-event aircraft position, if visible, compared to Asiana flight 214)

SEQUENCE OF EVENTS (ON-SCENE DATA)--AIRCRAFT PERFORMANCE GROUP

Notes: (1) Time type is as follows: LAN=Local time from ATC Audio Norcal Appch; LAT=Local time from ATC SFO tower; LR=Local time from Radar; LC5106=Local time from SFO Security Camera C5106; LC225=Local time from SFO security camera C225; F=FDR sec (elapsed); C=CVR; CAM=Cockpit Area Microphone

TIME SYNCHRONIZATION DATA				
LOCAL	FDR		SOURCE	
11:27:49		Time of Impact on Video C5106 and C225		
	97912	FDR--time of impact		

	SYNCHRONIZED							
Time type	LOCAL	TO IMPACT	FDR sec	Local time	Time to impact	Event	Source of information	Notes
LAN	11:21:56	-353	97559	11:21:56		Asiana Flight 214 reports field in sight.	Reference Attachment 6 "Transcripts_cert TRACON ONLY.pdf"	
LAN	11:21:57	-352	97560	11:21:57		Norcal Approach assigns heading 310 deg and clears Asiana 214 for Visual approach, Runway 28 Left. Asiana acknowledges at 11:22:02	Reference Attachment 6 "Transcripts_cert TRACON ONLY.pdf"	
LAN	11:23:17	-272	97640	11:23:17		Norcal Approach directs Asiana 214 to slow to 180 knots and to maintain 180 knots until five mile final due to traffic behind.	Reference Attachment 6 "Transcripts_cert TRACON ONLY.pdf"	
F	11:25:32	-137	97775			AP Pitch, Roll and Yaw engaged, the autoflight pitch and roll modes selected were VS and LOC respectively, the aircraft heading was approximately 280 degrees magnetic, speed was 180 knots, radar altitude was 2500 ft, rate of descent was 1500 ft/min, pitch angle was positive 1 deg, the Landing Gear was down and the Flaps were at 5.	FDR	
LAN	11:25:39	-130	97782	11:25:39		Norcal Approach directs Asiana 214 to switch to San Francisco tower. Asiana 214 acknowledges	Reference Attachment 6 "Transcripts_cert TRACON ONLY.pdf"	
F	11:25:44	-125	97787			The altitude in the Mode Control Panel (MCP) was changed from 1800 ft to 3000 ft. The aircrafts radio altitude at this point was about 2250 ft	FDR	
LAT	11:25:56	-113	97799	11:25:56		Asiana Flight 214 report on tower frequency; this transmission is not acknowledged.	Reference Attachment 6 "ARR214.certified.transcript.lc TOWER ONLY.pdf"	
F	11:26:02	-107	97805			The aircraft's flap handle is moved to the Flaps 20 position, the flaps achieve the setting about 12 seconds later at a speed of approximately 175 knots and a radar altitude of approximately 1750 ft.	FDR	
F	11:26:24	-85	97827			The aircraft's flap handle is moved to the Flaps 30 position, the flaps achieve the setting about 17 seconds later at a speed of approximately 160 knots and a radar altitude of approximately 1200 ft.	FDR	
F	11:26:24	-85	97827			The autopilot pitch mode is changed from "VS" (Vertical Speed) to "FLCH" (Flight Level Change). At the same time, the Autothrottle mode changed from "SPD" (Speed) to "THRUST" (Thrust mode). The aircraft's autoflight system responded by starting a climb toward the MCP altitude of 3000 ft and by adding thrust (increase in Thrust Lever Angle--TLA).	FDR	

SEQUENCE OF EVENTS (ON-SCENE DATA)--AIRCRAFT PERFORMANCE GROUP

Notes: (1) Time type is as follows: LAN=Local time from ATC Audio Norcal Appch; LAT=Local time from ATC SFO tower; LR=Local time from Radar; LC5106=Local time from SFO Security Camera C5106; LC225=Local time from SFO security camera C225; F=FDR sec (elapsed); C=CVR; CAM=Cockpit Area Microphone

TIME SYNCHRONIZATION DATA				
LOCAL	FDR		SOURCE	
11:27:49		Time of Impact on Video C5106 and C225		
	97912	FDR--time of impact		

	SYNCHRONIZED							
Time type	LOCAL	TO IMPACT	FDR sec	Local time	Time to impact	Event	Source of information	Notes
F	11:26:27	-82	97830			The Autopilot is disengaged.	FDR	
F	11:26:29	-80	97832			Flaps 30 is selected.	FDR	
F	11:26:31	-78	97834			TLA is noted to decrease slightly to about 34 degrees, Autothrottle mode changes from "THRUST" to "HOLD". Radar altitude at this point is about 1500 ft.	FDR	
F	11:26:36	-73	97839			The MCP airspeed is changed from about 152 knots to 137 knots.	FDR	
F	11:26:37	-72	97840			FDR Shows four FLAPERON channels displaying a retraction of the Flaperons. This begins at a speed of about 165 knots and a radio altitude of about 1300 ft. Flaperons return to fully extended position at about time 97880, with speed at about 135 knots. During this time, the rate of descent starts from about 1000 ft/min and peaks at a maximum value of 1776 ft/min (at time 97863). Rate of descent decreases to about 1100 ft/min with a decreasing rate of descent trend as the Flaperons return to fully extended position (Time 97880; airspeed is about 135 knots and radio altitude is about 400 ft)	FDR	For a description of the 777 Landing Attitude Modifier (LAM) function, refer to the 777 Maintenance Manual, see excerpt in Attachment 8. For a detailed plot of related information, refer to Attachment 5 ("[LONGITUDINAL]" plot)
F	11:26:44	-65	97847			The CAPT Flight Director (FD) switch is turned off. The First Officer's FD switch appears to remain on. The CAPT and F/O FD switch parameters are recorded once every four seconds on the FDR and once every second on the QAR. No further autopilot or autothrottle mode changes are evident until just prior to impact.	FDR	
F	11:26:52	-57	97855			Descending through 1000 radio altitude, the airspeed is about 153 knots, MCP selected target speed remains 137 knots, vertical descent rate is about 1500 ft/min.	FDR	
LAT	11:26:59	-50	97862	11:26:59		Asiana 214 reports "short final" to Tower	Reference Attachment 6 "ARR214.certified.transcript.lc TOWER ONLY.pdf"	
LAT	11:27:08	-41	97871	11:27:08		Tower clears Asiana 214 to land runway 28 Left	Reference Attachment 6 "ARR214.certified.transcript.lc TOWER ONLY.pdf"	

SEQUENCE OF EVENTS (ON-SCENE DATA)--AIRCRAFT PERFORMANCE GROUP

Notes: (1) Time type is as follows: LAN=Local time from ATC Audio Norcal Appch; LAT=Local time from ATC SFO tower; LR=Local time from Radar; LC5106=Local time from SFO Security Camera C5106; LC225=Local time from SFO security camera C225; F=FDR sec (elapsed); C=CVR; CAM=Cockpit Area Microphone

TIME SYNCHRONIZATION DATA				
LOCAL	FDR		SOURCE	
11:27:49		Time of Impact on Video C5106 and C225		
	97912	FDR--time of impact		

	SYNCHRONIZED							
Time type	LOCAL	TO IMPACT	FDR sec	Local time	Time to impact	Event	Source of information	Notes
LAT	11:27:10	-39	97873	11:27:10		Asiana 214 acknowledges landing clearance	Reference Attachment 6 "ARR214.certified.transcript.lc TOWER ONLY.pdf"	
F	11:27:13	-36	97876			Asiana 214 is at about 500 ft radio altitude at 137 knots airspeed.	FDR	
F	11:27:29	-20	97892			Beginning at 97892 and lasting through about 97912 the Stall Protection function of the Primary Flight Control (PFC) system is active.	FDR	For a description of the primary flight control (PFC) stall protection system, refer to the elevator system description in Attachment 7.
C	11:27:31	-18	97894		-18	Ground Proximity Warning System (GPWS) automated altitude callout "200" annunciates.	Chairman's statement during Press briefing, based on CVR	
LC225	11:27:34	-15	97897	11:27:34		Asiana 214 is seen on SFO Security Camera "T2 ROOF TOWER 2 C225" (refered to hereafter as "C225") approaching Runway 28L. From this time, through 11:28:19 (Camera C225 local time stamp), Camera C225 shows a similar sequence of events as C5106, including the rotation of the aircraft following impact and the departure of a large object moving rapidly from the left wing (probably the #1 engine, based on post-crash investigation).	Video analysis. See Storyboard in Figure 9.	
CAM	11:27:38	-11.3	97900.7			[sound of quadruple chime]	CVR	
C	11:27:40	-9	97903		-9	Ground Proximity Warning System (GPWS) automated altitude callout "100" annunciates.	Chairman's statement during Press briefing, based on CVR	
LC5106	11:27:41	-8	97904	11:27:41		Asiana 214 is seen on SFO Security Camera "P WTR TXWY L M W C5106" (refered to hereafter as "C5106") approaching Runway 28L	Video analysis. See Storyboard in Figure 3.	
F	11:27:42	-7	97905			Left and right engine TLA increase toward value of 84 in a period of about 1 second and the AT mode changed from “Hold” to “Thrust.” The radio altitude was about 75 ft and airspeed was approximately 108 knots. Angle of attack was about 12 degrees.	FDR	
CAM	11:27:45	-4.2	97907.8			[sound similar to stick shaker] until 97910	CVR	
F	11:27:45	-4	97908			The Stick Shaker is activated. Speed is about 103 knots and radio altitude is about 45 feet at this point. Angle of attack was about 15 degrees.	FDR	
C	11:27:46	-3	97909		-3	One of the cockpit crew calls for a go-around.	Chairman's statement during Press briefing, based on CVR	
LC5106	11:27:46	-3	97909	11:27:46		Asiana 214 is seen on Camera C5106 pitching up slightly on short final to Runway 28L	Video analysis. See Storyboard in Figure 4.	

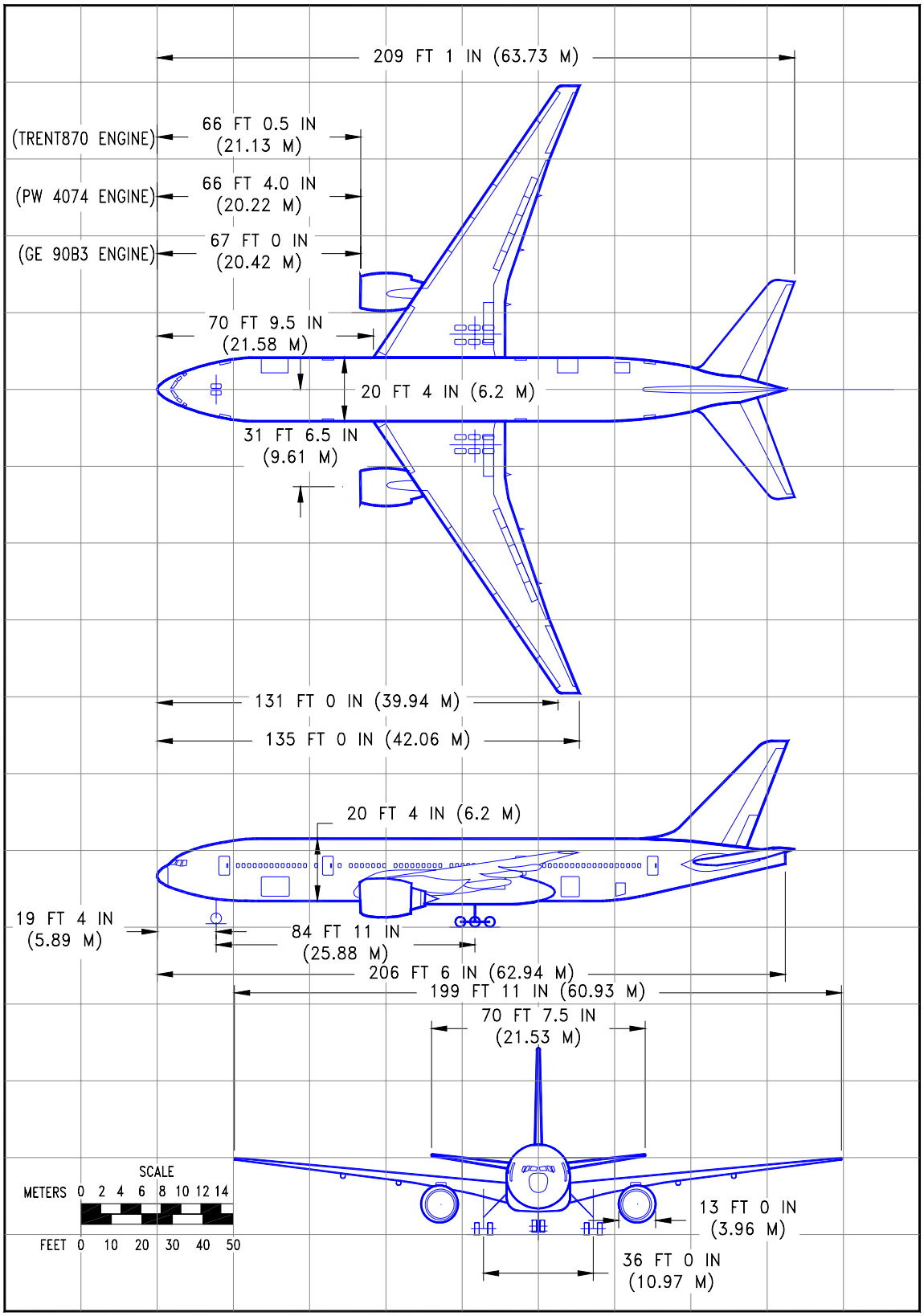
SEQUENCE OF EVENTS (ON-SCENE DATA)--AIRCRAFT PERFORMANCE GROUP

Notes: (1) Time type is as follows: LAN=Local time from ATC Audio Norcal Appch; LAT=Local time from ATC SFO tower; LR=Local time from Radar; LC5106=Local time from SFO Security Camera C5106; LC225=Local time from SFO security camera C225; F=FDR sec (elapsed); C=CVR; CAM=Cockpit Area Microphone

TIME SYNCHRONIZATION DATA				
LOCAL	FDR		SOURCE	
11:27:49		Time of Impact on Video C5106 and C225		
	97912	FDR--time of impact		

	SYNCHRONIZED							
Time type	LOCAL	TO IMPACT	FDR sec	Local time	Time to impact	Event	Source of information	Notes
CAM	11:27:47	-2	97910			end of [sound similar to stick shaker] since 97907.8	CVR	
C	11:27:47	-1.5	97910.5		-1.5	One of the cockpit crew calls for a go-around.	Chairman's statement during Press briefing, based on CVR	
CAM	11:27:49	-0.3	97911.7			[sound of broadband impulsive noise]	CVR	
F	11:27:49	0	97912			Spikes noted in FDR Longitudinal, Lateral and Vertical acceleration parameters. Approximate time of initial impact.	FDR	
LC5106	11:27:49	0	97912	11:27:49		Asiana 214 is seen on Camera C5106 impacting the ground--time is approximate.	Video analysis. See Storyboard in Figure 5.	
LC5106	11:27:51	2	97914	11:27:51		Camera C5106 shows vertical stabilizer and rudder departing aircraft. Time is approximate.	Video analysis. See Storyboard in Figure 6.	
CAM	11:27:53	3.7	97915.7			[sound of quadruple chime]	CVR	
LC5106	11:27:53	4	97916	11:27:53		Camera C5106 shows two large panels or surfaces flying through the air, detached from and behind Asiana 214. Time is approximate.	Video analysis. See Storyboard in Figure 7.	
LC5106	11:27:54	5	97917	11:27:54		From this time, through 11:28:32 (Camera C5106 local time stamp), Camera C5106 shows the path of the aircraft during the rest of the crash sequence. The aircraft is observed to yaw to the left, rotating almost 360 degrees with the wings and fuselage mostly airborne, pivoting around the nosewheel area. Additionally, a large object (believed to be the #1 engine based on post crash survey) is observed departing the aircraft approximately half way through it's left rotation. Following departure from the aircraft the object is observed to travel at relatively high speed in the general direction of Runway 28L.	Video analysis. See Storyboard in Figure 8.	
CAM	11:27:54	5.3	97917.3			[sound of quadruple chime]	CVR	
CAM	11:27:56	7.2	97919.2			[sound of quadruple chime]	CVR	
CAM	11:27:59	9.5	97921.5			[sound of quadruple chime]	CVR	
LC5106	11:28:14	25	97937	11:28:14		Camera C5106 shows approximate time aircraft fuselage and wing stop. A large dust or smoke cloud surrounds the aircraft, making exact time of stop difficult to determine.	Video analysis. See Storyboard in Figure 8.	
LAT	11:28:26	37	97949	11:28:26		Asiana 214 calls tower	Reference Attachment 6 "ARR214.certified.transcript.lc TOWER ONLY.pdf"	
LAT	11:28:29	40	97952	11:28:29		Tower says "Heavy emergency vehicles responding."	Reference Attachment 6 "ARR214.certified.transcript.lc TOWER ONLY.pdf"	

Attachment 1: B777-200 Drawing & General Specifications



2.2.1 GENERAL DIMENSIONS

MODEL 777-200

Search 777

Commercial Airplanes
About Commercial Airplanes
About Our Products
737
747
767
777
777 Family
Technical Information
Exterior Views
Interior Views
General Technical Characteristics
777-200/-200ER
777-300
Longer-Range 777s
777 Freighter
Detailed Technical Characteristics
Range Charts - Full Passenger
Range Charts - Freighter
787 Dreamliner
Boeing Business Jets
Boeing Freighters
Out-of-Production Models
Available Aircraft
Orders and Deliveries
The Boeing Edge
StartupBoeing
Other Services
About Our Market

777-200/-200ER Technical Characteristics

	777-200	777-200ER
Passengers Typical 3-class configuration Typical 2-class configuration Typical 1-class configuration	 305 400 up to 440	 301 400 up to 440
Cargo	Total volume 5,330 cu ft (151 cu m) includes up to six pallets, 14 LD-3 containers, plus 600 cu ft (17 cu m) bulk cargo.	same
Engines maximum thrust	Pratt & Whitney 4077 77,000 lb Rolls-Royce Trent 877 76,000 lb General Electric GE90-77B 77,000 lb	Pratt & Whitney 4090 90,000 lb Rolls-Royce Trent 895 93,400 lb General Electric 90-94B 93,700 lb
Maximum Fuel Capacity	31,000 U.S. gal (117,340 L)	45,220 U.S. gal (171,170 L)
Maximum Takeoff Weight	545,000 lbs (247,200 kg)	656,000 lbs (297,550 kg)
Maximum Range	5,240 nautical miles (9,700 km) Typical city pairs: London - New York Denver - Honolulu Tokyo - San Francisco	7,725 nautical miles (14,305 km) Typical city pairs: London - Los Angeles Tokyo - Sydney Chicago - Seoul
Typical Cruise Speed at 35,000 feet	0.84 Mach	Same
Basic Dimensions Wing Span Overall Length Tail Height Interior Cabin Width Diameter	 199 ft 11 in (60.9 m) 209 ft 1 in (63.7 m) 60 ft 9 in (18.5 m) 19 ft 3 in (5.86 m) 20 ft 4 in (6.19 m)	 199 ft 11 in (60.9 m) 209 ft 1 in (63.7 m) 60 ft 9 in (18.5 m) 19 ft 3 in (5.86 m) 20 ft 4 in (6.19 m)

5.1 General

5.1.1 Airplane General, Emergency Equipment

Airplane Number		7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
IDENT Page Model	777-200.1	○	○	○	○									777-200ER
	777-200.3					○	○	○	○	○	○	○	○	777-200ER with extended forward CG
Configuration	First	-	-	-	-	-	-	-	-	-	8	8	8	
	Business	28	28	28	28	28	24	24	24	24	28	28	24	
	Travel	271	272	272	271	271	271	271	271	271	226	226	214	
	Total	299	300	300	299	299	295	295	295	295	262	262	246	
Crew Rest Compartment	Flight Deck	○	○	○	○	○					○	○		Smoke Detection
	Door 1 Upper												○	Smoke Detection
	Lower	○	○	○	○	○	○	○	○	○	○	○		Smoke Detection Fire Extinguishing Sys'
	Door 3 Upper												○	Smoke Detection
Emergency Equipment Locations	Type 1	○	○	○	○	○								FCOM Chapter1Sec.45
	Type 2							○	○					〃
	Type 3						○			○				〃
	Type 4										○	○		〃
	Type 5												○	〃

5.1.2 Automatic Flight

Airplane Number	7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
Automatic LNAV Activation after G/A										○	○	○	FCOM Ch.4 Sec.20

5.1.3 Communications

Airplane Number	7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
Intermittent Tone with Stuck Mic												○	FCOM Ch.5 Sec.20

5.1.4 Flight Instruments, Displays

Airplane Number	7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
PFD Navigation Performance Indication										○	○	○	FCOM Ch.10 Sec.10
ND Navigation Performance Indication										○	○	○	FCOM Ch.10 Sec.10
SIDE Cursor Location S/W								○	○	○	○	○	CCD

Airplane Number	7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
Integrated Standby Flight Display					○	○	○	○	○	○	○	○	
Dual Data Base (ECL)											○		FCOM Ch.10 Sec.60
EFB (Electronic Flight Bag)								○	○	○	○	○	

5.1.5 Flight Management, Navigation

Airplane Number		7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
Transponder providing selective interrogation and downlink information						○	○	○	○	○	○	○	○	FCOM Ch.11 Sec.20
Default STEP SIZE	ICAO	○	○	○	○									
	RVSM/ICAO/0					○	○	○	○	○	○	○	○	As selected in AMI
Assumed Temp, APU-to-Pack, OAT													○	FCOM Ch.11 Sec.40
REF NAV DATA (Key 6R)	VOR/DME NAV	○	○	○	○									FCOM Ch.11 Sec.42
	RAD NAV INHIBIT					○	○	○	○	○	○	○	○	

5.1.6 Warning Systems

Airplane Number		7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	
Highest Elevation of Obstacle or Terrain Displayed											○	○	○	FCOM 15.10.15
Lowest Elevation of Obstacle or Terrain Displayed											○	○	○	
TCAS Voice Annunciation	"LEVEL OFF, LEVEL OFF"												○	FCOM 15.20.18
	"ADJUST VERTICAL SPEED, ADJUST"	○	○	○	○	○	○	○	○	○	○	○		
Look-ahead Obstacles and Peaks Terrain Alerting System											○	○	○	FCOM 15.20.22

5.1.7 MTOW

Airplane Number		7500	7596	7597	7700	7732	7739	7742	7755	7756	7775	7791	8254	Remarks
MTOW	632,500LBS	○	○	○			○	○	○	○				
	648,000LBS				○	○								
	656,000LBS										○	○	○	

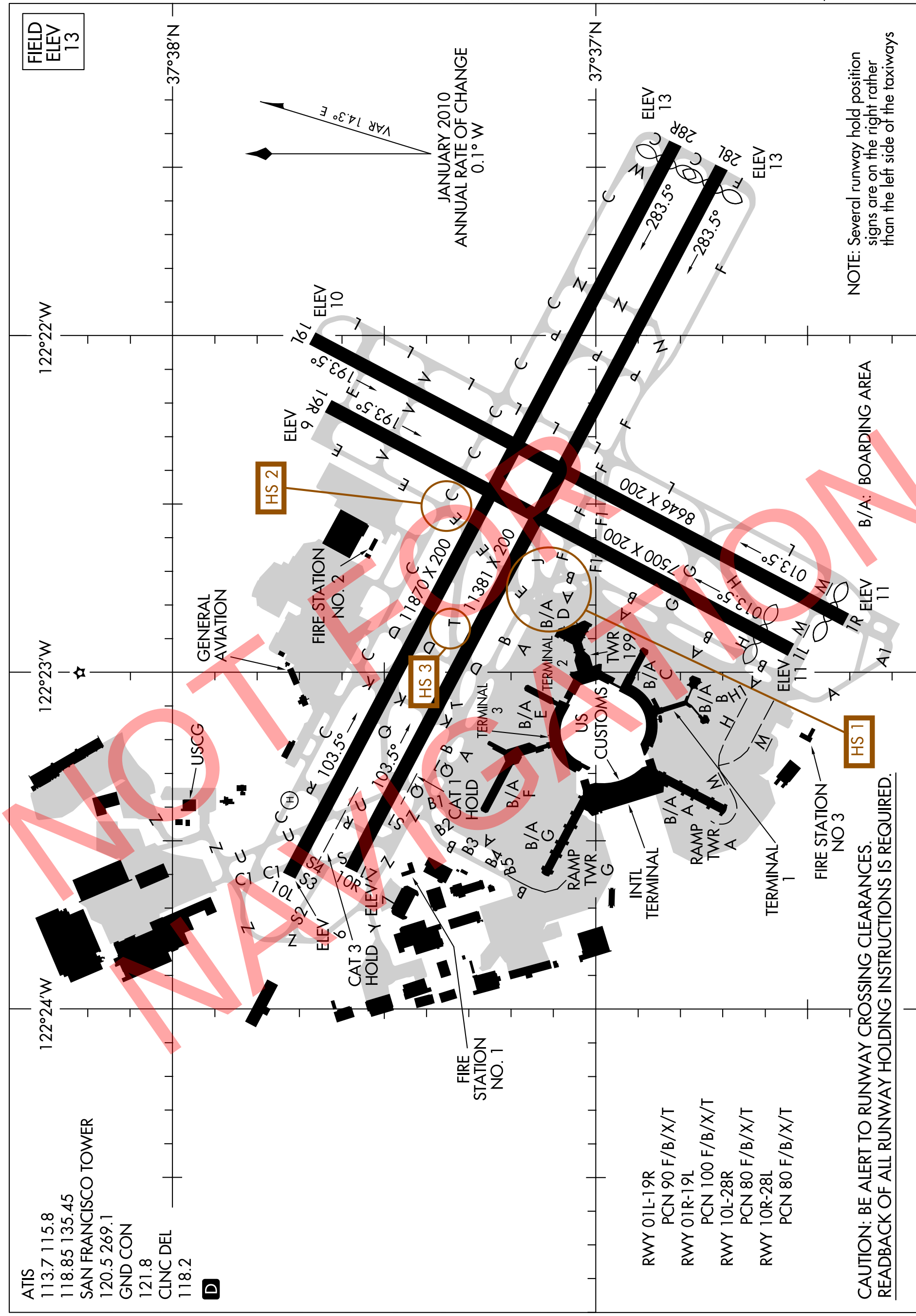
The end of section

Attachment 2: KFSO Airport, Runway, & Approach Information

AIRPORT DIAGRAM

AL-375 (FAA)

SAN FRANCISCO INTL (SFO)
SAN FRANCISCO, CALIFORNIA



AIRPORT DIAGRAM

SAN FRANCISCO, CALIFORNIA
SAN FRANCISCO INTL (SFO)

CALIFORNIA **NFDD 082 - 4** 04/29/2013

SAN FRANCISCO

SAN FRANCISCO INTL AIRPORT (SFO) 02187.A

LATITUDE - 37-37-08.7781 N LONGITUDE - 122-22-30.8539 W

RWY ID	10L/28R		
RWY END	28R		
THRESH DSPLCD	300	EFF: 06/27/2013	ADDED
DSPL THR ELEVATION	12.7	EFF: 06/27/2013	ADDED
DSPL THR ELEV DATE	22-OCT-2012	EFF: 06/27/2013	ADDED
DSPL THR ELEV SOURCE	FAA	EFF: 06/27/2013	ADDED
DSPL THR LATITUDE	37-36-50.1019 N	EFF: 06/27/2013	ADDED
DSPL THR LONGITUDE	122-21-29.0045 W	EFF: 06/27/2013	ADDED
DSPL THR PSN DATE	22-OCT-2012	EFF: 06/27/2013	ADDED
DSPL THR PSN SOURCE	FAA	EFF: 06/27/2013	ADDED
THR CROSSING HGT	68	EFF: 06/27/2013	MODIFIED
RWY ID	10R/28L		
RWY END	28L		
THRESH DSPLCD	300	EFF: 06/27/2013	ADDED
DSPL THR ELEVATION	12.6	EFF: 06/27/2013	ADDED
DSPL THR ELEV DATE	22-OCT-2012	EFF: 06/27/2013	ADDED
DSPL THR ELEV SOURCE	FAA	EFF: 06/27/2013	ADDED
DSPL THR LATITUDE	37-36-43.5437 N	EFF: 06/27/2013	ADDED
DSPL THR LONGITUDE	122-21-33.3539 W	EFF: 06/27/2013	ADDED
DSPL THR PSN DATE	22-OCT-2012	EFF: 06/27/2013	ADDED
DSPL THR PSN SOURCE	FAA	EFF: 06/27/2013	ADDED
THR CROSSING HGT	64	EFF: 06/27/2013	MODIFIED

Rpt Date:07/08/2013

KSFO

SAN FRANCISCO INTL

SAN FRANCISCO

AL# :375

Report : RWY002

Magnetic Variation/Year:

Dir:	E	Variance:	17	Year:	1975

Landing Strip

Surface:	ASPH	G	Width:	200	Physical Length:	11381

Rwy Number: 28L

Status: A Survey: 8T

Markings: PIR-G

Threshold

Latitude: N 37° 36' 42.1529"
Longitude: W 122° 21' 30.0312"
Elevation: 12.7
Elipsoid Elev: -94.3 S
Horz. Datum: NAD83
Vert. Datum: NAVD88

Displaced Threshold

Latitude:
Longitude:
Elevation:
Elipsoid Elev:
Horz. Datum: NAD83
Vert. Datum: NAVD88

Landing Length: 11381
FI RWY Length: 11381
FI RWY Height: 7.2
Tdz Elevation: 12.7
True Bearing: 297.81
Feet Displaced from Threshold:
Gradient: 0.0%
RVR Touchdown: Yes
MidPoint: Yes
Rollout: Yes

RWY Survey: VG 09/13/2011 THIRD PARTY

Assoc. Fac: SFO ILS (A)

VGSI Lights

Commissioned
Date:
Angle: 3.00

Type	Thres Cross Ht	High Angle
PAPI-4L	75	
Owner	Pilot Cntrl Freq	
F		

DownWind Bar
Elevation:
Threshold:

Reference Point:
Latitude: N 37° 36' 48.8300"
Longitude: W 122° 21' 45.9500"
Elevation: 9.4
Threshold: 1448.0

Lights

Config	Len	Owner	Com Dt	Pilot Cntl
SSALR		F		
C/L		F		
HIRL		F		

Rwy Number: 10R

Status: A Survey: 8T

Markings: PIR-G

Threshold

Latitude: N 37° 37' 34.6441"
Longitude: W 122° 23' 35.1795"
Elevation: 7.2
Elipsoid Elev: -99.7 E
Horz. Datum: NAD83
Vert. Datum: NAVD88

Displaced Threshold

Latitude:
Longitude:
Elevation:
Elipsoid Elev:
Horz. Datum: NAD83
Vert. Datum: NAVD88

Landing Length: 11381
FI RWY Length: 11381
FI RWY Height: 12.7
Tdz Elevation: 9.7
True Bearing: 117.79
Feet Displaced from Threshold:
Gradient: 0.0%
RVR Touchdown: Yes
MidPoint: Yes
Rollout: Yes

RWY Survey:

Assoc. Fac:

VGSI Lights

Commissioned
Date: 11/29/2007
Angle: 3.00

Type	Thres Cross Ht	High Angle
PAPI-4L	75	
Owner	Pilot Cntrl Freq	
F		

DownWind Bar
Elevation:
Threshold:

Reference Point:
Latitude: N 37° 37' 24.4800"
Longitude: W 122° 23' 10.9300"
Elevation: 6.0
Threshold: 1430.0

Lights

Config	Len	Owner	Com Dt	Pilot Cntl
C/L		F		
HIRL		F		

GPS Procedures

Procedure

Control	Description	Proc Type	Amendment
21198	RNAV (RNP) Z RWY 10R	PROC/P	1

FLIGHT INSPECTION REPORT

NONDIRECTIONAL BEACON, DIRECTION FINDING,
VISUAL AIDS, COMMUNICATIONS

1. FLIGHT INSPECTION REPORT HEADER

IDENT	OWNER	STATE	CTRY	REGION	INSPECTION DATE(S)
KSFO28L	F	CA	US	AWP	07/02/13

LOCATION	INSP TYPE
SAN FRANCISCO	R

2. CREW INFORMATION

PIC	SIC	MS	A/C NO
VN251	VN307	VN294	N59

ACM	FIFO
	SAC

3. FACILITY INFORMATION

DIRECTION FINDING		NDB		FACILITY STATUS	Unrestricted
COMMUNICATIONS		NDB/DME		SIAP(s) VERIFIED	
VISUAL AIDS	Inspected				

4. NOTAMs

5. REMARKS

S-08-154-12 reconfiguration of PAPI to runway 28L. Run 1: Box 2=3.18, Box 3=2.81 Angle=3.0. Run 2: Box 2=3.14, Box 3=2.78 Angle 2.96. Final=2.98. * ILS SIAP and RNAV SIAP both marked not coincident due to TCH. *Electronic Glideslope OTS at time of inspection.

6. FLIGHT INSPECTION DATA

A. NONDIRECTIONAL BEACON

RADIO CLASS CODE		IDENTIFICATION		INTERFERENCE		VOICE	
FREQUENCY		COVERAGE		OSCILLATIONS		BRG ACCURACY	
DME CHANNEL		STA PASSAGE		STANDBY EQUIP.		STANDBY POWER	

B. DIRECTION FINDING

STATION PASSAGE

STANDBY POWER

CHECKPOINT	AIRCRAFT ALTITUDE	AIRCRAFT DISTANCE	BEARING			FREQUENCY USED
			AIRCRAFT	DF	ERROR	

C. VISUAL AIDS

FACILITY INSPECTED ALS ☐ REIL ☐ VASI ☐ PAPI ☑ OTHER* ☐

RUNWAY(S) SERVED	28L	INTENSITY	Sat	SEQUENCE FLASHERS		FOCUS AND ADJUST.	Sat	RUNWAY LIGHTS	
G.S. ANGLE	Sat	ANGULAR COVERAGE	Sat	OBST. CLEAR. (VGSI)	Sat	COINC. (PAR/ILS/MLS)	-*	RADIO CTRL SYST.	
2.85/2.98									

D. COMMUNICATIONS

APPROACH CONTROL ☐ FSS ☐ TOWER ☐ CENTER ☐ OTHER* ☐ P/F ☐ CS/T ☐

FREQUENCY USED	PRIMARY	SECONDARY	VOICE QUALITY	COVERAGE	STANDBY POWER

** Remarks are required for fields marked with an asterisk*

FLIGHT INSPECTION REPORT
INSTRUMENT LANDING SYSTEM

1. FLIGHT INSPECTION REPORT HEADER

IDENT	OWNER	STATE	CTRY	REGION	INSPECTION DATE(S)
KSFO28L	F	CA	US	AWP	07/02/13

LOCATION	RUNWAY	CATEGORY	INSP TYPE
SAN FRANCISCO	28L	I	R

2. CREW INFORMATION

PIC	SIC	MS	A/C NO
VN251	VN307	VN294	N59

ACM	FIFO
	SAC

3. FACILITY INFORMATION

LOCALIZER	Inspected
OFFSET	
GLIDE SLOPE	Required, Not Inspected*
LDA	
SDF	
TLS	
OTHER*	

DME	Inspected/Sat
COMPASS LOCATOR	
LIGHTING SYSTEM	Required, Not Inspected*
75 mHz MARKERS	
SIAP	
PUBLICATIONS	Sat

COMD WIDTH	3.34
COMD ANGLE	
GLIDE SLOPE TYPE	

FACILITY STATUS	
F/C	Unrestricted
G/S	Unusable*
B/C	
ILS CLASS. SYS.	I T
INSP. CRITERIA	
ROLLOUT	

4. NOTAMs

5. REMARKS

S-08-154-12 reconfiguration of PAPI to runway 28L. Run 1: Box 2=3.18, Box 3=2.81 Angle=3.0. Run 2: Box 2=3.14, Box 3=2.78 Angle 2.96. Final=2.98. * ILS SIAP and RNAV SIAP both marked not coincident due to TCH. *Electronic Glideslope OTS at time of inspection.

** Remarks are required for fields marked with an asterisk*

6. INSTRUMENT LANDING SYSTEM DATA - AZIMUTH (PART I)

A. FRONT COURSE

ILS-1 ALTITUDE

	TX 1			TX 2		
	CD	INITIAL	FINAL	CD	INITIAL	FINAL
Course Width			3.33			
Symmetry			49.8			
Modulation			39.7			
Clearance 150			237/16.3			
Clearance 90			211/19.9			
Structure-Z 1			1/4.07			
Structure-Z 2			2/0.58			
Structure-Z 3			1/0.32			
Structure-Z 4			1/0.37			
Structure-Z 5			2/1.20			
Vert. Polar.			S			
Alignment			CL			
Identification			S			
Power Ratio						
Loc Only Structure						

B. BACK COURSE

ILS-1 ALTITUDE

	TX 1			TX 2		
	CD	INITIAL	FINAL	CD	INITIAL	FINAL
Course Width						
Symmetry						
Modulation						
Clearance 150						
Clearance 90						
Structure-Z 1						
Structure-Z 2						
Structure-Z 3						
Vert. Polar.						
Alignment						
Identification						

7. INSTRUMENT LANDING SYSTEM DATA - GLIDE SLOPE (PART I)

ILS-2 ALTITUDE

	TX 1			TX 2		
	CD	INITIAL	FINAL	CD	INITIAL	FINAL
Angle						
Modulation						
Width						
Structure Below Path						
Symmetry						
Structure-Z 1						
Structure-Z 2						
Structure-Z 3						
Angle Alignment "B-C"						
Angle Alignment "C-T"						
Angle Alignment "T"						

8. INSTRUMENT LANDING SYSTEM DATA - MARKER WIDTH(s)

A. OM

B. MM

C. IM

** Remarks are required for fields marked with an asterisk*

FLIGHT INSPECTION REPORT
AFTER ACCIDENT CONTINUATION SHEET

1. GENERAL

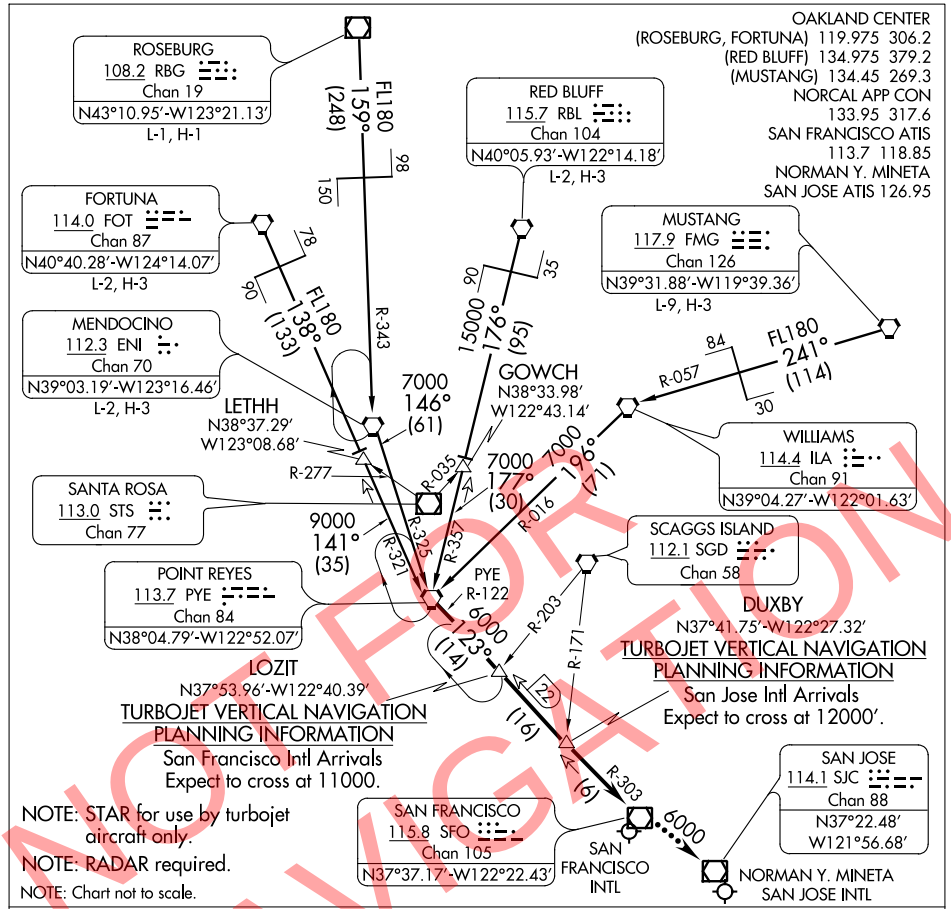
A. Location	San Francisco, CA
B. Ident	SFO
C. Facility Type	ILS
D. Date(s) of Inspection	7/7/13
E. Date & Time of Accident	7/6/13 1833Z
F. Aircraft Type & Number	BOEING 777 / HL7742

2. OTHER INFORMATION

A. Procedures In Use at Time of Accident	SAN FRANCISCO INTERNATIONAL, SAN FRANCISCO, CA VISUAL APROACH RUNWAY 28L
B. Equipment In Use at Time of Accident	UNKNOWN
C. Date & Time of After Accident Inspection	7/7/13 1732Z
D. Weather Conditions at Time of Accident	10 MILES VISIBILITY, 1500 FOOT SCATTERED CEILING, WINDS 070 DEGREES AT 13 KNOTS, TEMPERATURE 17 DEGREES, DEWPOINT 11 DEGREES, BAROMETRIC PRESSURE 29.85
E. Procedures Inspected and Extent of Inspection	SAN FRANCISCO INTL, SAN FRANCISCO, CA, LOC/DME Y RWY 28L ORIG FINAL SEGMENT ONLY
F. SIAP	Sat
G. Name & Routing Symbol of Accident Coordinator/Investigator	TONY F JAMES / FAA AVP-100

3. REMARKS

LOCALIZER FACILITY OPERATION FOUND SATISFACTORY



FORTUNA TRANSITION (FOT.GOLDN6): From over FOT VORTAC via FOT R-138 to LETHH INT, then via PYE R-321 to PYE VORTAC. Thence....

MENDOCINO TRANSITION (ENI.GOLDN6): From over ENI VORTAC via ENI R-146 and PYE R-325 to PYE VORTAC.

MUSTANG TRANSITION (FMG.GOLDN6): From over FMG VORTAC via FMG R-241 and ILA R-057 to ILA VORTAC, then via ILA R-196 and PYE R-016 to PYE VORTAC. Thence....

RED BLUFF TRANSITION (RBL.GOLDN6): From over RBL VORTAC via RBL R-176 to GOWCH INT, then via PYE R-357 to PYE VORTAC. Thence....

ROSEBURG TRANSITION (RBG.GOLDN6): From over RBG VOR/DME via RBG R-159 and ENI R-343 to ENI VORTAC, then via ENI R-146 and PYE R-325 to PYE VORTAC. Thence....

....From over PYE VORTAC via SFO R-303 to SFO VOR/DME. Expect radar vectors to final approach course.

LOST COMMUNICATIONS: San Jose Intl: After SFO VOR/DME proceed direct SJC VOR/DME.

SAN FRANCISCO, CALIFORNIA

AL-375 (FAA)

ILS PRM RWY 28L
(SIMULTANEOUS CLOSE PARALLEL)
SAN FRANCISCO INTL (SFO)

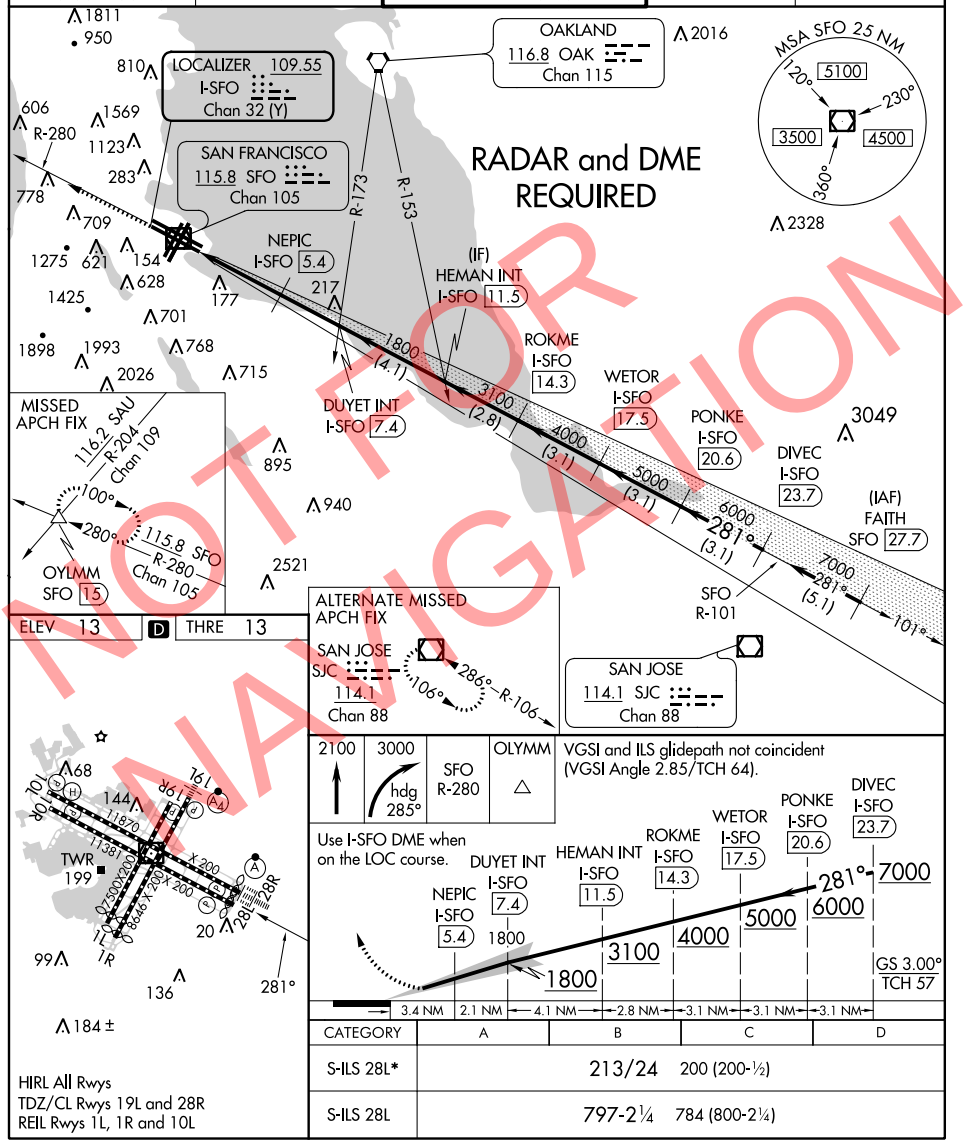
LOC/DME I-SFO	APP CRS	Rwy Idg	10681
109.55	281°	THRE	13
Chan 32 (Y)		Apt Elev	13

Runway 28L and 28R separated by 750 feet centerline to centerline. Simultaneous Close Parallel approach authorized with LDA PRM Rwy 28R. Procedure NA when glide slope not available. Dual VHF comm required. See additional requirements on AAUP.
*Missed approach requires minimum climb of 310 feet per NM to 2100.

NA

MISSED APPROACH: Climb to 2100 then climbing right turn to 3000 on heading 285° and SFO VOR/DME R-280 to OLYMM INT/SFO 15 DME and hold.

ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL
113.7 115.8 118.85 135.45	134.5 338.2	120.5 269.1 PRM 125.15	121.8	118.2



CATEGORY	A	B	C	D
S-ILS 28L*	213/24	200 (200-½)		
S-ILS 28L	797-2¼	784 (800-2¼)		

HIRL All Rwys
TDZ/CL Rwys 19L and 28R
REIL Rwys 1L, 1R and 10L

ILS or LOC Z RWY 28L

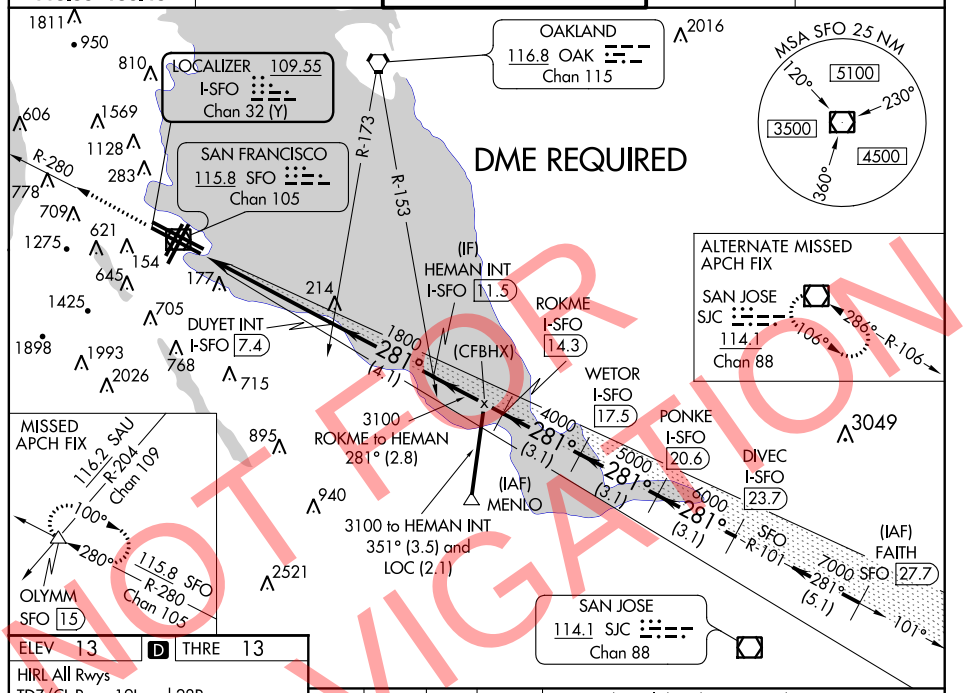
SAN FRANCISCO INTL (SFO)

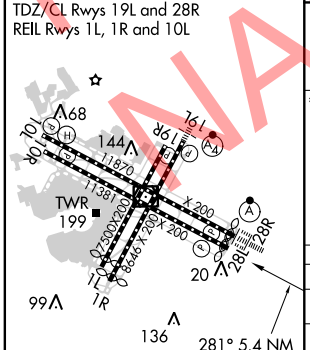
LOC/DME I-SFO	APP CRS	Rwy Idg	10681
109.55	281°	THRE	13
Chan 32 (Y)		Apt Elev	13

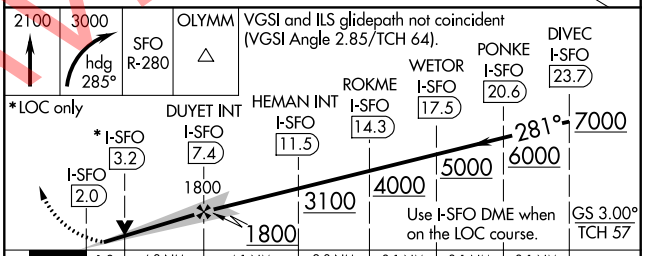
When VGSI inop, Circling Rwy 10R NA at night.
Circling to Rwys 1L, 1R, and 19R NA at night.
Missed approach requires a minimum climb of 310 feet per NM to 2100.
† RVR 1800 authorized with the use of FD or AP or HUD to DA.

MISSED APPROACH: Climb to 2100 then climbing right turn to 3000 on heading 285° and SFO VOR/DME R-280 to OLYMM INT/SFO 15 DME and hold.

ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL
113.7 115.8 118.85 135.45	134.5 338.2	120.5 269.1	121.8	118.2







CATEGORY	A	B	C	D
S-ILS 28L #†	213/24 200 (200-½)			
S-ILS 28L	797-2¼ 784 (800-2¼)			
S-LOC 28L #	460/24 447 (500-½)		460/45 447 (500-⅞)	
S-LOC 28L	940/40 927 (1000-¾)		940-2 927 (1000-2)	
CIRCLING	940-1¼ 927 (1000-1¼)		1040-3 1027 (1100-3)	1160-3 1147 (1200-3)

FAF to MAP 5.4 NM					
Knots	60	90	120	150	180
Min:Sec	5:24	3:36	2:42	2:10	1:48

SW-2, 27 JUN 2013 to 25 JUL 2013

WAAS CH 53415 W28B	APP CRS 281°	Rwy Idg 10681 THRE 13 Apt Elev 13

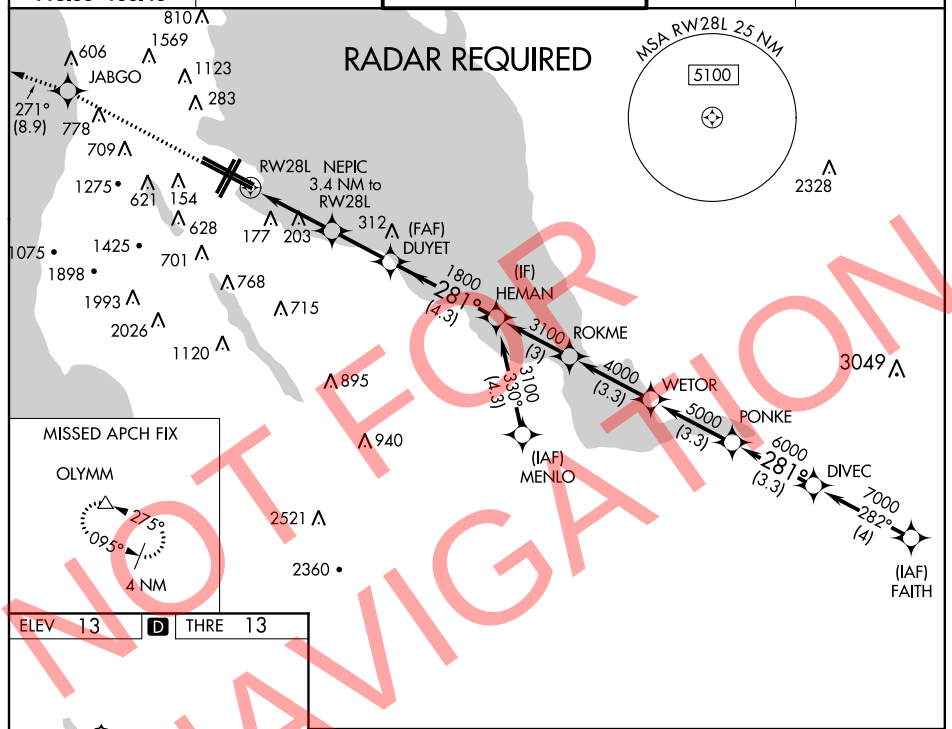
RNAV (GPS) RWY 28L

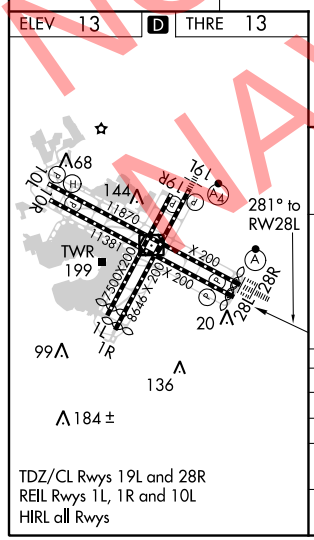
SAN FRANCISCO INTL (SFO)

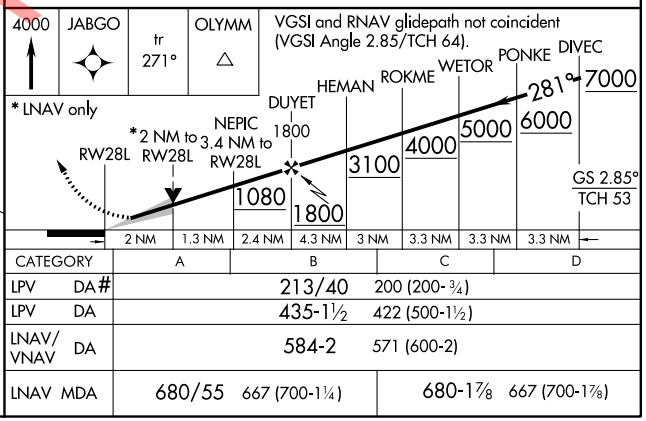
DME/DME RNP-0.3 NA. For uncompensated Baro-VNAV systems, LNAV/VNAV NA below 2°C (36°F) or above 54°C (130°F).
#Missed approach requires minimum climb of 220 feet per NM to 1300.

MISSED APPROACH: Climb to 4000 direct JABGO and on track 271° to OLYMM and hold, continue climb-in-hold to 4000.

ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL
113.7 115.8 118.85 135.45	134.5 338.2	120.5 269.1	121.8	118.2







CATEGORY		A	B	C	D
LPV	DA#	213/40	200 (200-¾)		
LPV	DA	435-1½	422 (500-1½)		
LNAV/VNAV	DA	584-2	571 (600-2)		
LNAV	MDA	680/55	667 (700-1¼)	680-1⅞	667 (700-1⅞)

SW-2, 27 JUN 2013 to 25 JUL 2013

LOC/DME I-SFO	APP CRS	Rwy Idg	10681
109.55	281°	THRE	13
Chan 32 (Y)		Apt Elev	13

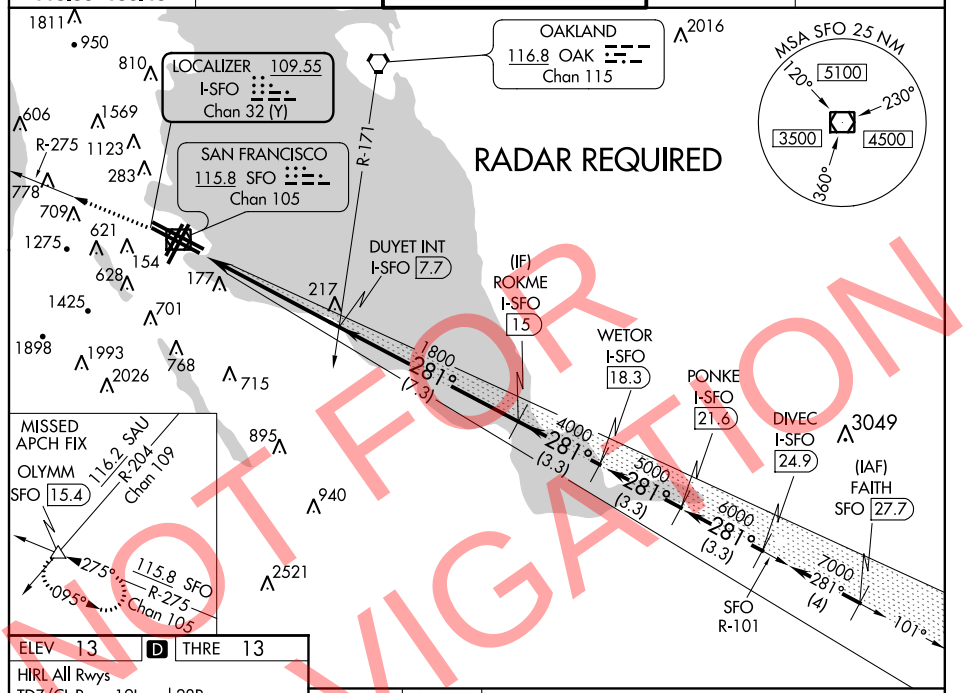
LOC/DME Y RWY 28L

SAN FRANCISCO INTL (SFO)

*Missed approach requires minimum climb of 250 feet per NM to 1700.

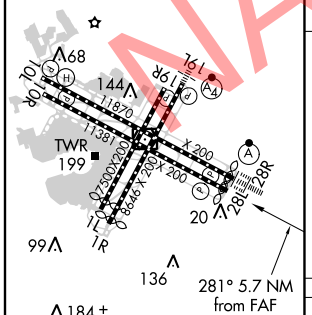
MISSED APPROACH: Climb to 4000 on SFO VOR/DME R-275 to OLYMM INT/SFO 15.4 DME and hold, continue climb-in-hold to 4000.

ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL
113.7 115.8 118.85 135.45	134.5 338.2	120.5 269.1	121.8	118.2



ELEV 13	D	THRE 13

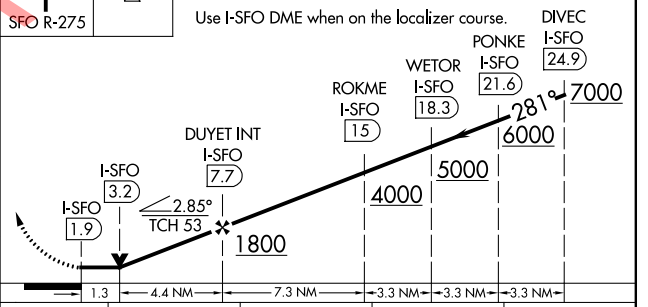
HIRL All Rwys
TDZ/CL Rwys 19L and 28R
REIL Rwys 1L, 1R and 10L



4000	OLYMM
SFO R-275	△

VGSI and descent angles not coincident (VGSI Angle 2.85/TCH 64).

Use I-SFO DME when on the localizer course.

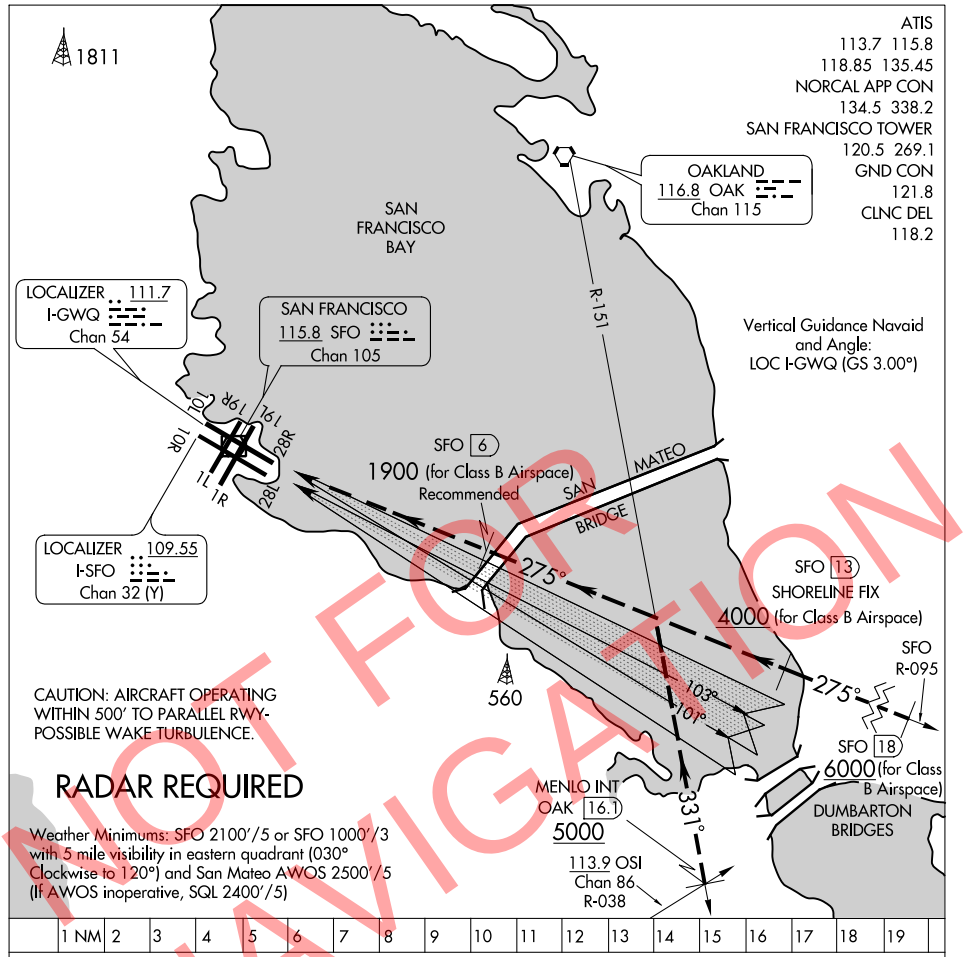


CATEGORY	A	B	C	D
S-28L*	460/55	447 (500-1¼)	460-1⅜	447 (500-1⅜)
S-28L	740/55	727 (800-1¼)	740-2	727 (800-2)

SW-2, 27 JUN 2013 to 25 JUL 2013

QUIET BRIDGE VISUAL RWYS 28L/R

SAN FRANCISCO INTL (SFO)
SAN FRANCISCO, CALIFORNIA



QUIET BRIDGE VISUAL APPROACH RWYS 28L/R

When visual approaches to Runways 28L/R are in progress, arriving aircraft may be vectored into a position for a straight-in visual approach to Runways 28L/R via the SFO VOR R-095.

SFO VOR and DME must be operating.

Aircraft should remain on the SFO R-095 until passing the San Mateo Bridge.

NOTE: Closely spaced parallel visual approaches may be in progress to Runway 28L utilizing I-SFO. In the event of a go-around on Runway 28L, turn left heading 265°, or on Runway 28R, turn right heading 310°, climb and maintain 3000, or as directed by Air Traffic Control.

QUIET BRIDGE VISUAL RWYS 28L/R
SAN FRANCISCO, CALIFORNIA
SAN FRANCISCO INTL (SFO)
Amdt 8 11069

SAN FRANCISCO, CALIFORNIA

AL-375 (FAA)

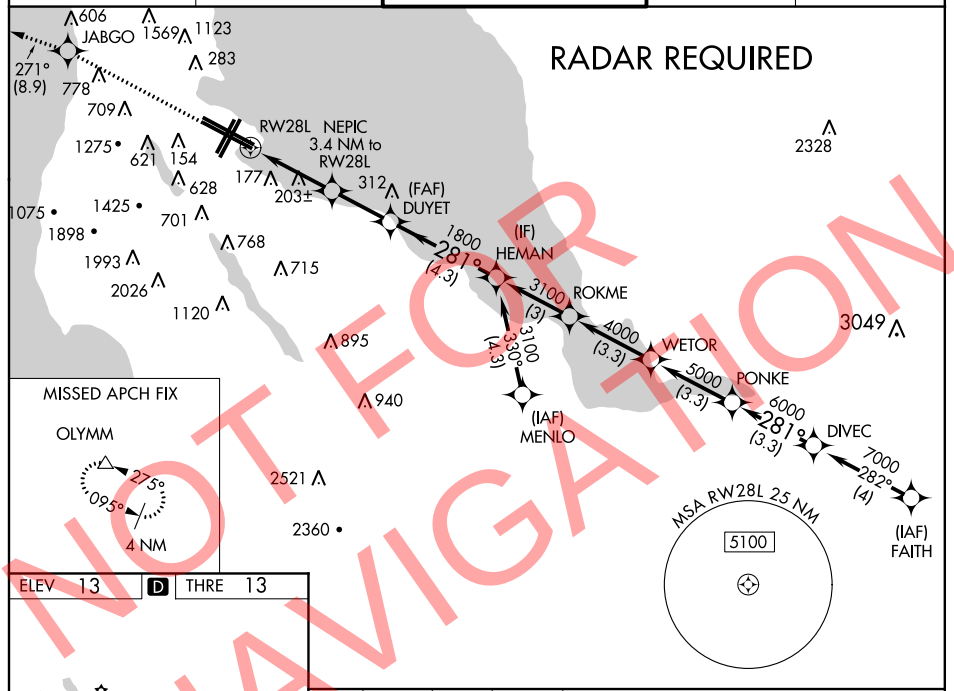
RNAV (GPS) PRM RWY 28L
(SIMULTANEOUS CLOSE PARALLEL)
SAN FRANCISCO INTL (SFO)

WAAS CH 53333 W28D	APP CRS 281°	Rwy Idg 10681 THRE 13 Apt Elev 13

DME/DME RNP-0.3 NA. Simultaneous approach authorized with LDA PRM RWY 28R and RNAV (GPS) PRM X RWY 28R. Dual VHF comm required. Rwy 28L and 28R separated by 750 feet centerline to centerline. For uncompensated Baro-VNAV systems, LNAV/VNAV NA below 2°C (36°F) or above 54°C (130°F). Use of FD or AP providing RNAV track guidance during simultaneous operations.
Missed approach requires minimum climb of 220 feet per NM to 1300.
See additional requirements on AAUP.

MISSED APPROACH: Climb to 4000 direct JABGO and on track 271° to OLYMM and hold, continue climb-in-hold to 4000.

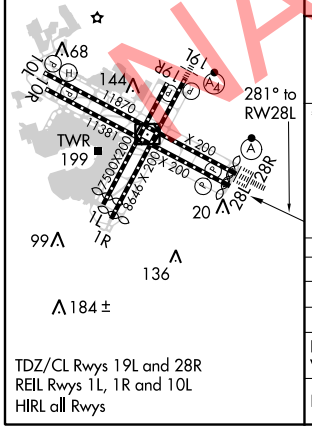
ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL
113.7 115.8 118.85 135.45	134.5 338.2	120.5 269.1 PRM 125.15	121.8	118.2



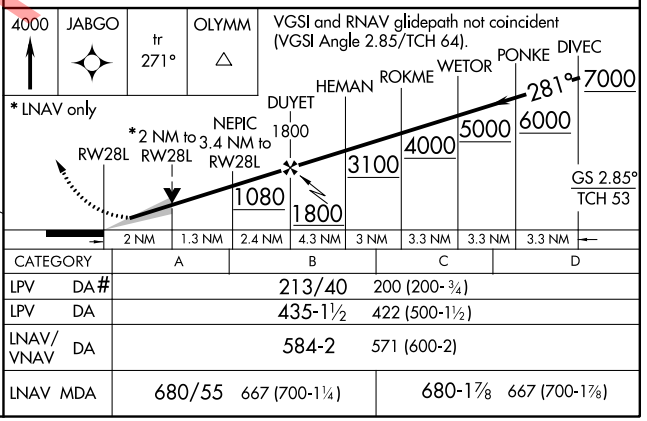
SW-2, 27 JUN 2013 to 25 JUL 2013

SW-2, 27 JUN 2013 to 25 JUL 2013

ELEV 13 | D | THRE 13



TDZ/CL Rwys 19L and 28R
REIL Rwys 1L, 1R and 10L
HIRL all Rwys



CATEGORY		A	B	C	D
LPV	DA#	213/40	200 (200-¾)		
LPV	DA	435-1½	422 (500-1½)		
LNAV/VNAV	DA	584-2	571 (600-2)		
LNAV	MDA	680/55	667 (700-1¼)	680-1⅞	667 (700-1⅞)

SAN FRANCISCO, CALIFORNIA
Orig 27JUN13

37°37'N-122°23'W

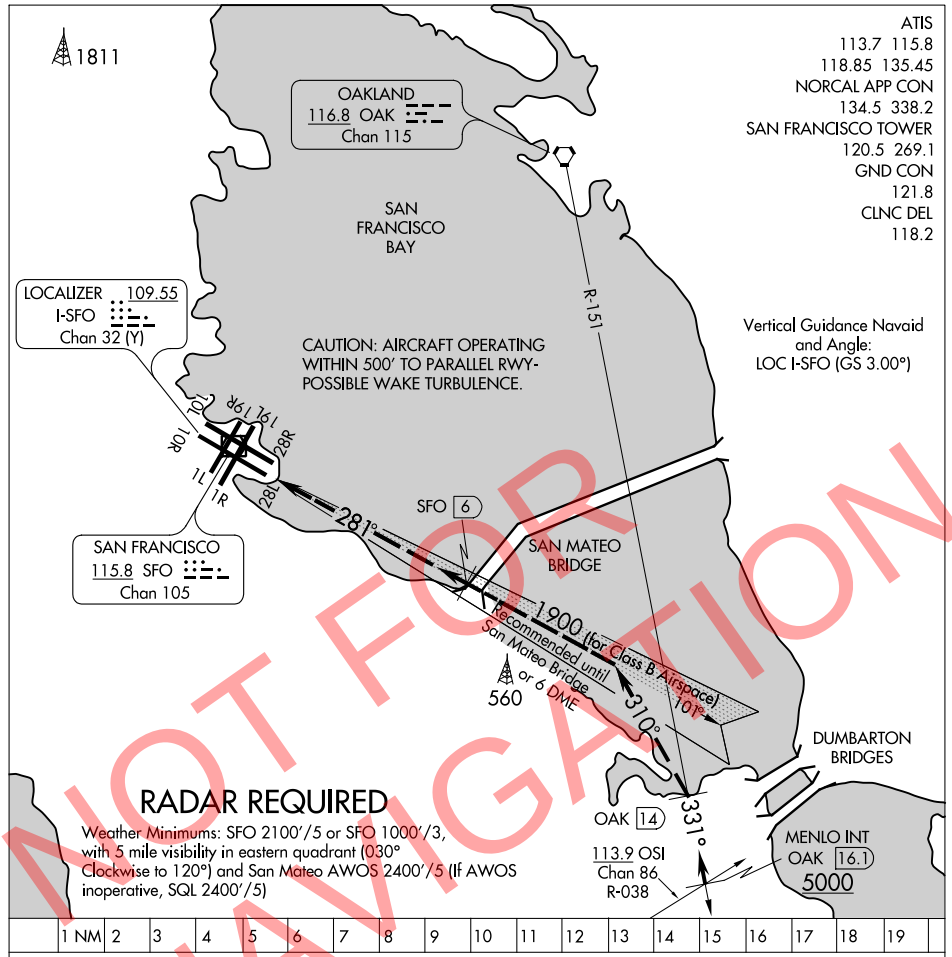
SAN FRANCISCO INTL (SFO)
(SIMULTANEOUS CLOSE PARALLEL)

RNAV (GPS) PRM RWY 28L

TIPP TOE VISUAL RWY 28L

AL-375 (FAA)

SAN FRANCISCO INTL (SFO)
SAN FRANCISCO, CALIFORNIA



TIPP TOE VISUAL APPROACH RUNWAY 28L

When visual approaches to Runway 28L are in progress, arriving aircraft may be cleared for a visual approach via the OAK VOR R-151 and I-SFO localizer.

The OAK VOR and DME and I-SFO must be operating.

Aircraft should cross the OAK R-151/16.1 DME (Menlo Int) at or above 5000 and the San Mateo Bridge at or above 1900.

NOTE: Closely spaced parallel visual approaches may be in progress to Runway 28R utilizing the SFO R-095. In the event of a go-around on Runway 28L, turn left heading 265°, climb and maintain 3000, or as directed by Air Traffic Control.

SW-2, 27 JUN 2013 to 25 JUL 2013

SW-2, 27 JUN 2013 to 25 JUL 2013

TIPP TOE VISUAL RWY 28L
SAN FRANCISCO, CALIFORNIA
SAN FRANCISCO INTL (SFO)
Orig 11069

37°37'N-122°22'W

Attachment 3: Asiana Flight 214 Records

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OZ214  RKSI/KSFO  06/JUL/2013     OFP 3/0/1:0401Z      PAGE  1/7
-------- -------- --------- --------- --------- --------- ---------

AAR214     06/JUL/2013 HL7742 B777-200ER  CHDS  APMS/4.3 ETOPS
WIND/TEMP P028/M45     DIST   5234/4949   SPD:  310.M83-CI030-M83.290

PAX :  0F-21C-279Y  TTL 295  CGO  7 TONS              TKOF ALTN:....
ICN/RKSI  P0900 : STD/ 07.30Z ETD/07.30   ATD-      /
SFO/KSFO  M0700 : STA/ 18.15Z ETA/18.04   ATA-      /

SPOT NR/COORD:

ICN.ENKAS.G597.LANAT.Y51.SAMON.Y513.KMC..GOC.OTR4.PABBA.OTR5.KALNA..
44N160E..47N170E..49N180E..49N170W..49N160W..48N150W..46N140W..
42N130W..VESPA..ENI.GOLDN6.SFO : ICNSFOT2
ICN/0310/KAE/0330/44E60/0350/49N70/0370/
---------- ---------- ---------- ---------- ---------- ----------

            FUEL   TIME           PLAN     ACTL            UNIT:100LBS

TRIP        1655   10.24          SOW 3252
CONT        0067   00.31 / 5%     PLD 0833     MTOW                6325
ALTN/KOAK   0045   00.19          ZFW 4085     MZFW 4300 TOF 1882  6181
HOLDING     0065   00.30          TOF 1882     MLDW 4600 TIF 1655  6255
E-RSV       0000   00.00          TOW 5966
RQRD        1832   11.43          TIF 1655
EXTRA  e100 ~~0050~~ 00.19 RSN/ATC LDW 4312     AGTOW               6181
PAD         0000   00.00
TKOF        1882   12.02                          EXTRA FUEL(U): 0000
TAXI        0010
RAMP        ~~1892~~   12.02 TCAP: 3029 / 6.7   TIF ADJ 1848/PLD 5000 LBS
            1902                 ********* TANKERING INFO *********
TTL  RSV    0227   01.39          * NO TANKERING RECOMMENDED (P)     *
                                  * LOSS FOR X-FUEL: 114 USD/1000LBS *
                                  ******** ******** ******** *********

ALTN SUMMARY:
 ALTN        DIST  FL   TIME   WIND  FUEL  RTE
 KOAK/29     075   090  00.19  P01   0045  DCT OAK DCT
 KLAX/25L    338   330  00.54  M02   0138  SHOR4 OAK J110 SNS DCT AVE
                                          DCT FIM SADDE6
 KLAS/25R    423   370  01.02  P09   0161  SHOR4 OAK J84 LIN DCT
                                          LIDAT J92 BTY J86 FUZZY
                                          FUZZY7

MEL/CDL INFO

 CDL 57-53-1          L/H WING FLAPERON LOWER INBOARD SEAL MIS
```

OZ214 RKSI/KSFO 06/JUL/2013 OFP 3/0/1:0401Z PAGE 2/7
MAX SR/04/KAE MIN OAT/M58/48N50

DST POINT FREQ AWY	FL MORA	MC TC	LAT LONGI	ETO ATO	REM ACTL	OT AT	WIND - WIND	COMP TP	SR G/S	TAS TIF/ACTF	ZT/ACTM
RKSI TAXI ELEV 0023FT			N037 27.8 E126 26.4		1882						
090 ENKAS	CL 048	96 88	N037 29.3 E127 22.8	...1778	20	26/031	P026		52	348	16/00.16 103/0103
ENKAS/ENKAS1L											
014 KARBU	CL 048	87 79	N037 32.0 E127 39.9	...1770	24	26/038	P034		52	458	01/00.17 009/0112
KARBU/G597											
045 JINBU	CL 062	87 79	N037 40.5 E128 35.2	...1746	31	24/072	P061		55	494	05/00.22 024/0135
JINBU/G597											
002 TOC	CL 062	87 79	N037 40.8 E128 37.6	...1745	33	24/073	P070		55	530	00/00.22 001/0136
/G597											
006 KAE 115.60	310 062	87 79	N037 42.0 E128 45.2	...1743	33	24/075	P072	04	55	500 523	01/00.23 002/0138
GANGWON/G597											
030 SORKA	330 058	129 121	N037 26.5 E129 17.5	...1730	36	24/086	P041	01	55	498 511	03/00.26 013/0152
SORKA/G597											
078 AGSUS	330 037	129 121	N036 45.4 E130 40.7	...1703	36	24/081	P034	01	55	500 516	09/00.35 027/0179
AGSUS/G597											
043 LANAT	330 010	130 122	N036 22.4 E131 25.7	...1688	35	23/071	P026	01	55	500 516	05/00.40 015/0193
LANAT/G597											-RJJJ
149 SAMON	330 030	100 92	N036 14.6 E134 30.2	...1638	35	23/055	P042	01	53	500 537	16/00.56 050/0243
SAMON/Y51											
093 KMC 112.00 -CCRP	330 039	91 84	N036 23.8 E136 24.3	...1608	35	24/049	P043	01	53	500 540	11/01.07 031/0274
KOMATSU VOR/Y513											
192 GOC 115.30	330 109	90 83	N036 44.7 E140 21.0	...1544	35	25/038	P036	01	53	500 536	21/01.28 064/0337
DAIGO/DCT											

OZ214 RKSI/KSFO 06/JUL/2013 OFP 3/0/1:0401Z PAGE 3/7

DST POINT FREQ AWY	FL MORA	MC LAT TC LONGI	ETO REM OT WIND - COMP SR TAS ZT/ACTM ATO ACTL AT ACTL - WIND TP G/S TIF/ACTF
103 TOPOS	330	91 N036 54.6	...1510 34 25/035 P033 00 500 12/01.40
	041	84 E142 28.9	49 533 034/0371
TOPOS/OTR4			
015 -RJJJ	330	92 N036 55.9	...1505 00 500 01/01.41
	013	85 E142 48.0	49 531 005/0376
/OTR4			-RJJJ
058 PABBA	330	92 N037 00.2	...1486 34 25/031 P031 00 500 07/01.48
	013	85 E143 59.8	49 531 019/0395
PABBA/OTR4			
010 ONION	330	88 N037 01.7	...1483 34 26/031 P031 00 500 01/01.49
	013	81 E144 12.4	49 530 003/0399
ONION/OTR5			
071 ADNAP	330	88 N037 11.8	...1459 34 27/028 P028 01 500 08/01.57
	013	81 E145 40.0	50 529 023/0422
ADNAP/OTR5			
229 KALNA	330	64 N039 09.2	...1383 34 28/023 P018 01 500 26/02.23
	013	58 E149 49.5	50 519 077/0499
KALNA/OTR5			
003 C-EEP	330	60 N039 10.9	...1382 02 500 01/02.24
	013	54 E149 52.6	50 515 001/0500
/DCT			
539 44E60	330	60 N044 00.0	...1203 35 30/024 P011 01 500 63/03.27
	013	54 E160 00.0	48 515 178/0678
N44E160_PACOTS/DCT			
160 -KZAK	350	67 N045 08.6	...1148 02 490 19/03.46
	013	63 E163 21.9	46 492 055/0733
/DCT			-KZAK
298 47E70	350	66 N047 00.0	...1050 44 35/040 M007 03 490 36/04.22
	013	63 E170 00.0	42 491 098/0831
N47E170_PACOTS/DCT			
414 1-ETP	350	70 N048 58.8	...0917 02 486 52/05.14
	010	70 E179 52.1	40 483 133/0964
/DCT			
005 49E80	350	66 N049 00.0	...0916 48 34/041 P005 01 486 00/05.14
	010	70 E180 00.0	40 483 002/0966
N49E180_PACOTS/DCT			

OZ214 RKSI/KSFO 06/JUL/2013 OFP 3/0/1:0401Z PAGE 4/7

DST POINT FREQ	AWY	FL MORA	MC TC	LAT LONGI	ETO ATO	REM ACTL	OT AT	WIND - WIND	COMP	SR TP	TAS G/S	ZT/ACTM TIF/ACTF
394 49N70		350	82	N049 00.0	...0798	52	28/046	P046		02	482	47/06.01
		010	86	W170 00.0						38	507	117/1083
N49W170_PACOTS/DCT												
394 49N60		370	78	N049 00.0	...0691	57	26/080	P078		01	476	43/06.44
		010	86	W160 00.0						38	544	108/1191
N49W160_PACOTS/DCT												
402 48N50		370	82	N048 00.0	...0583	58	28/049	P049		01	474	45/07.29
		010	95	W150 00.0						41	534	107/1298
N48W150_PACOTS/DCT												
150 2-ETP		370	87	N047 23.7	...0543					02	476	18/07.47
		010	103	W146 23.4						40	516	041/1339
/DCT												
276 46N40		370	87	N046 00.0	...0468	57	31/030	P028		01	476	32/08.19
		010	103	W140 00.0						39	516	075/1413
N46W140_PACOTS/DCT												
408 C-EXP		370	99	N042 45.3	...0357					01	478	48/09.07
		010	116	W131 38.3						38	505	111/1524
/DCT												
086 42N30		370	100	N042 00.0	...0334	55	27/032	P029		02	478	11/09.18
		010	116	W130 00.0						37	505	023/1547
N42W130_PACOTS/DCT												
139 -KZAK		370	105	N040 47.8	...0297					01	480	16/09.34
		010	120	W127 21.5						40	505	037/1585
/DCT												-KZAK
019 VESPA		370	105	N040 37.5	...0292	52	26/028	P021		01	480	02/09.36
		010	120	W127 00.0						40	505	005/1590
VESPA/DCT												
003 -KZOA		370	102	N040 36.1	...0291						482	01/09.37
		046	118	W126 56.4						40	501	001/1591
/DCT												-KZOA
176 TOD		370	102	N039 11.8	...0244	51	24/030	P017			482	21/09.58
		046	118	W123 35.7						51	501	047/1638
/DCT												
017 ENI		DC	103	N039 03.2	...0243	47	25/018	P018				02/10.00
112.30		046	118	W123 16.5						51	493	001/1639
MENDOCINO/DCT												

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OZ214  RKSI/KSFO  06/JUL/2013      OFP 3/0/1:0401Z       PAGE  5/7
--------- -------- --------- --------- --------- --------- ---------
DST POINT     FL    MC LAT      ETO REM  OT WIND - COMP SR TAS ZT/ACTM
FREQ   AWY    MORA TC LONGI    ATO ACTL AT ACTL - WIND TP G/S TIF/ACTF
--------- -------- --------- --------- --------- --------- ---------
054 -KZOA     DC  139 N038 25.5...0239                          09/10.09
              046 154 W122 52.5                          50 354 004/1643
/GOLDN6                                                          -KZOA
--------- --------- --------- --------- --------- --------- ---------
KSFO   TAXI           N037 37.1   0227                          15/10.24
069 ELEV 0013FT       W122 22.5                                 012/1655
--------- -------- --------- --------- --------- --------- ---------

ONE FL BLW.  TIF 1684  TIME 10.19  WIND/P027
RKSI/0290/KAE/0310/44E60/0330/49N70/0350/
```

OZ214 RKSI/KSFO 06/JUL/2013 OFP 3/0/1:0401Z PAGE 6/7

180 MINS ETOPS SUMMARY :

ETOPS ENTRY(RJSS) : N39 10.9 E149 52.6 EET 02.24
ETOPS EXIT (KPDX) : N42 45.3 W131 38.3 EET 09.07

	TIME OF OPS
UHMM	1228Z/1730Z
PANC	1525Z/1856Z
CYQQ	1653Z/1923Z

		DIST	TIME	WIND	ICE	CFR/FOB	COND
ETP1	UHMM/PANC	1196/1251	03.32	M008/P011	040	672/0917	DC-UHMM

N48 58.8 E179 52.1 EET 05.14

		DIST	TIME	WIND	ICE	CFR/FOB	COND
ETP2	PANC/CYQQ	837/863	02.27	P006/P014	026	445/0543	DC-CYQQ

N47 23.7 W146 23.4 EET 07.47

ADV CFP VALID UNTIL:1330Z 06/JUL/2013

THIS FLIGHT IS RELEASED IN ACCORDANCE WITH APPLICABLE REGULATIONS.

DISP OR AGENT NOH JEONG GWAN . . . . . .

PILOT IN COMMAND Leejungmin C.P.T / LEE JONG JUN GSM

UPPER WIND/TEMP DATA: PROG 0606 0609 0612 0615 0618 0621

WPT	WIND/OAT 10000	15000	20000	31000	35000
CLB	24008P09	25009M01	26018M11	24073M33	24073M40

	(25000)	(28000)	(31000)	(34000)	(37000)	(40000)
TOC	26032M22	25051M28	24073M33	24075M38	25068M43	25062M49
KAE	26032M22	25051M28	24075M33	24077M39	25070M43	25063M49
SORKA	26039M21	25061M27	24086M32	24085M38	24073M44	25065M49
AGSUS	25052M19	24067M24	24079M30	24082M38	24078M45	24071M51
LANAT	25055M18	24063M23	23068M30	23072M37	24075M45	24073M52
SAMON	24049M16	24052M23	24053M30	23056M37	23057M45	24059M52
KMC	24049M16	24048M22	24048M29	23049M37	23049M45	24052M53
GOC	25042M17	25040M23	25038M29	24037M37	24036M45	24036M53
TOPOS	25038M16	25037M23	25034M29	25035M37	25033M45	25032M53
PABBA	25035M17	25033M23	25031M29	25031M37	26029M45	26026M53
ONION	25034M17	25033M23	25031M29	25031M37	26028M45	26025M53
ADNAP	26032M17	26031M23	26030M29	27027M37	27022M45	27020M53
KALNA	26031M17	27029M23	27026M29	28022M37	29024M45	29028M53
44E60	28025M17	29025M24	29024M31	31025M39	31038M47	31048M55
47E70	35017M22	34023M29	34028M37	35037M44	35047M52	34056M59
49E80	31018M26	31022M33	33028M40	34039M47	34047M53	34049M58
49N70	27045M27	28044M34	28047M42	28046M50	27048M57	27048M58
49N60	25063M27	25066M35	25070M43	26079M51	26080M57	26070M58
48N50	27033M27	27036M35	28041M42	28045M51	28049M58	28053M62
46N40	30026M27	30028M35	30031M42	31031M50	31030M57	29038M60
42N30	29025M27	28028M34	28031M41	28031M48	27032M52	27027M53

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OZ214   RKSI/KSFO  06/JUL/2013      OFP 3/0/1:0401Z       PAGE  7/7
VESPA  29021M26  28022M33  27021M41  27024M48  26028M52  26028M53
TOD    27013M25  26015M32  25018M40  25024M46  24030M50  25036M53

         39000       35000       31000       20000       10000
DSC    24036M52    25025M47    25018M40    28010M12    31001P10
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[ATC Flight Plan]

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--------------------------------------------------------------------------
FF RKSIZPZX RKSIZTZX RKRRZQZX RKRRYFYX RKSSZTZX RJJJZQZX RJAAYSYX
KZAKZQZX KZAKZOZX KZOAZQZX KSFOXSFO
       RKSSAARO
(FPL-AAR214-IS
-B772/H-SDE1E2E3FGHIJ5M1RWXY/LB1D1
-RKSI0730
-N0499F310 ENKAS G597 KAE/N0498F330 G597 LANAT/N0500F330 Y51 SAMON
 Y513 KMC DCT GOC OTR4 TOPOS/M083F330 OTR4 PABBA OTR5 KALNA DCT
 44N160E/M083F350 47N170E 49N180E 49N170W/M083F370 49N160W 48N150W
 46N140W 42N130W DCT VESPA DCT ENI GOLDN6
-KSFO1024 KOAK
-PBN/A1B1C1D1S1S2 DOF/130706 REG/HL7742 EET/RJJJ0040 PABBA0147
 ONION0148 ADNAP0156 KALNA0223 44N160E0326 KZAK0346 47N170E0422
 49N180E0514 49N170W0600 49N160W0644 48N150W0729 46N140W0818
 42N130W0917 VESPA0936 KZOA0937 SEL/CHDS CODE/71BF42 OPR/AAR
 RALT/UHMM PANC CYQQ RMK/TCAS II EQUIPPED)
```

L O A D S H E E T 777-200 ALL WEIGHTS IN LBS

FLT NR DATE FROM/TO REG NR VERSION CREW PRINT EDNR

OZ0214 /06JUL ICN/SFO HL7742 24C/271Y 2/ 1/11 07JUL/1021 02

WEIGHT DISTRIBUTION

LOAD IN COMPARTMENTS 22706 1/ 3219 2/ 7040 3/ 1903

4/ 10435 5/ 111

PASSENGER/CABIN BAG 45790 A/262 C/ 30 I/ 1 TTL293 CAB 0

BAG PC/WT 304/ 10245 PAX BY CLASS F/ 0 C/ 21 Y/271

SEAT-ROW TRIM A/ 21 B/157 C/114

WEIGHT	I.U.	C.G.		
325008	33.21		DRY OPERATING WT.	L RTOW 618099
68496			TOTAL PAYLOAD	
393503	45.87	28.47	ZERO FUEL WT.	MZFW 429998
193200			TAKE OFF FUEL	
586703	43.60	28.41	TAKE OFF WT.	MTOW 632499
-165499			TRIP FUEL	
421204			LANDING WT.	MLDW 459999
			ALLOWABLE GROSS WT.A	AGTOW 618099

TAXI FUEL 1001 TAXI WGT 587704 MRMW 634499

UNDERLOAD BEFORE LMC 31396

LAST MINUTE CHANGES

DEST SPEC CL/CPT - WEIGHT

.

PANTRY CODE U

PREPARED BY DISPATCH OR AGENT SIGN KIM HONG RYANG

APPROVED BY CAPTAIN SIGN

Aviation Fuel Delivery Receipt

International 2013-07-06 12:51:37 Fuel

Remain Fuel	
Approval no	
LBS	141
USG	

ADR NO	1-13576828
Date	2013-07-06
Order	~~184,100~~ 180,000 (1657 / 2,200)
(Revised)	194200

Supplied by AAR	FLT NO OZ0214	Airport ICN
ETA 2013-07-07 17:25	REG NO 7742	AC Type B777200
ETD 2013-07-06 16:30	Route ICN / SFO	Spot No 45

Batch No	Tank No	Test No
AASFF13T10723	107	R-13-182

Temp.	LBS/USG	S.G	Water Check
23	6.580	0.788	N/L

※Density is of tank on line and may differ from product being delivered. If density is critical to safety of operation, airline should verlty independently. ※Tank on line, product ex hydrant may be different.

Vehicle No.	AAS-3-319	AAS-3-322	
Gauge After	2 (1772 채정범) 6350963444660		
Gauge Before	2124704463433440		
Issue(Delivery)	① 16465	② 11220	③
Service Started	14 : 49	14 : 49	
Service Completed	15 : 20	15 : 14	
Service Time	31 Min	25 Min	Min
Delivered by	박 창 호	김 영 배	

Product	Unit	Quantuty(① + ② + ③)
JET A-1	USG	27685

Received by Crew	Received by Engineer
	11772 채정범

AAS AIRPORT SERVICES

HL7742 (B777-200ER)

- Weighing Date — 1) 2011.07.01
- Scale — 2) AN60-6
- Place Weighed — 3) AMECO - BEIJING
- As Weighed — 4) WHEEL DOWN, FLAP UP

	5) READ 1	6) OFFSET	ACTUAL	7) READ 2	8) OFFSET	ACTUAL	9) READ 3	10) OFFSET	ACTUAL	AVR	SUM
NOSE L/H	17411.0	-1.0	17412.0	17558.0	2.0	17556.0	17591.0	-1.0	17592.0	17520.00	34047.00
NOSE R/H	16418.0	1.0	16417.0	16548.0	-1.0	16549.0	16613.0	-2.0	16615.0	16527.00	
L/H MAIN No.1	26311.0	-2.0	26313.0	25517.0	0.0	25517.0	25369.0	3.0	25366.0	25732.00	136881.33
L/H MAIN No.2	23889.0	-7.0	23896.0	23478.0	1.0	23477.0	23482.0	0.0	23482.0	23618.33	
L/H MAIN No.5	23998.0	-3.0	24001.0	24000.0	1.0	23999.0	23865.0	0.0	23865.0	23955.00	
L/H MAIN No.6	14723.0	3.0	14720.0	14861.0	0.0	14861.0	14967.0	-3.0	14970.0	14850.33	
L/H MAIN No.9	26781.0	-2.0	26783.0	27066.0	1.0	27065.0	27110.0	2.0	27108.0	26985.33	
L/H MAIN No.10	21275.0	-1.0	21276.0	21932.0	0.0	21932.0	22015.0	2.0	22013.0	21740.33	
R/H MAIN No.3	24922.0	-1.0	24923.0	24538.0	-1.0	24539.0	24211.0	1.0	24210.0	24557.33	138774.33
R/H MAIN No.4	26642.0	1.0	26641.0	25936.0	-1.0	25937.0	25431.0	0.0	25431.0	26003.00	
R/H MAIN No.7	16948.0	0.0	16948.0	17110.0	-2.0	17112.0	17237.0	-3.0	17240.0	17100.00	
R/H MAIN No.8	21530.0	1.0	21529.0	21419.0	0.0	21419.0	21411.0	0.0	21411.0	21453.00	
L/H MAIN No.11	23288.0	2.0	23286.0	23933.0	-3.0	23936.0	24311.0	1.0	24310.0	23844.00	
L/H MAIN No.12	25529.0	-1.0	25530.0	25819.0	0.0	25819.0	26104.0	2.0	26102.0	25817.00	
			309675.0			309718.0			309715.0		

11) < RESULTS >

POINTS	WT (lbs)	ARM (in)	M-W (in-lbs)
NOSE GEAR	34047.00	324.50	11048251.50
L / H MAIN GEAR	136881.33	1343.99	183967143.19
R / H MAIN GEAR	138774.33	1343.99	186511316.26
TOTAL	309702.67	1231.91	381526710.94

12) < OVERAGE >

ITEMS	WT (lbs)	ARM (in)	M-W (in-lbs)
GROUND LOCKS, NOSE	0.40	310.00	124.00
GROUND LOCKS, M.L.G	2.80	1340.00	3752.00
PLUMB BOB	1.00	1340.00	1340.00
FUEL, TRAPPED USABLE	82.20	1229.00	101023.80
SOFTWARE BINDERS	39.20	236.00	9251.20
			0.00
TOTAL	125.60	919.51	115491.00

13) < SHORTAGE >

ITEMS	WT (lbs)	ARM (in)	M-W (in-lbs)
DRAINABLE FUEL, UNUSABLE	175.40	1225.00	214865.00
			0.00
			0.00
TOTAL	175.40	1225.00	214865.00

< B.E.W COMPUTATION >

ITEMS	WT (lbs)	ARM (in)	M-W (in-lbs)
As Weighed	309702.67	1231.91	381526710.94
14) MOMENT CHG 0 to 30 DEGREES			119400.00
Overage Total	125.60	919.51	115491.00
Shortage Total	175.40	1225.00	214865.00
TOTAL	309752.47	1232.42	381745484.94

* FWD OF MAC = 1174.5

※ CENTER OF GRAVITY (% MAC) = 57.921 / 2.785 = 20.798

- 기입요령 -

1) Weighing Date : Weighing 수행 날짜를 기록
1) Weighing Date : Write the date of Weighing performed

2) Scale : Weighing Scale의 Model name 기록
예) AN60-5, AN60-6

2) Scale : Write the Model name of Weighing Scale
Example : AN60-5, AN60-6

3) Place Weighed : Weighing 장소를 기록
3) Place Weighed : Write "Place"

4) As Weighed : Weighing 당시 항공기의 상태 기록
예) Wheel Down, Flap up or Wheel Down Flap Down

4) As Weighed : Write the Aicraft configuration
Example : Wheel Down, Flap up or Wheel Down Flap Down

5,7,9) Read 1,2,3 : 측정값 기록
5,7,9) Read 1,2,3 : Write the measurement

6,8,10) Offset 1,2,3 : 측정후 Scale의 잔류 수치 기록
6,8,10) Offset 1,2,3 : Write the staying value on the scale after measurement

11) Arm : 항공기 Main L/G Arm 값을 구해서 기록 (WBM L/G Graph 참고)
11) Arm : Write the All L/G arm distance as refer to WBM L/G graph

12) Overage Item : Weighing 시 필요하나, 운항 시 불필요한 Item
12) Overage Item : Write the Overage items which are need for Weighing but not need for flight
Example : Landing Gear Safety Lock and etc.

13) Shortage Item : Weighing 시 불필요하나 운항 시 필요한 Item
예) Drainable Unusable Fuel, 각종 Component류 (WBM #02 List에서 찾는다)

13) Shortage Item : Writhe the Shortage items which are not need for Weighing but need for flight
Example : Drainable Unusable Fuel, Components as refer to WBM #02 List.

14) Moment CHG : Flap Full Extend Position시 Moment Data 삭제
14) Moment CHG : At Flap Full Extend Position, Moment Data should be zero.

QU BKKIRXA
.SELFAOZ **060712** 12
CMD
AN HL7742
- QDSELFAOZ~1 WTB INFO
ENDR 02/1612 ALL WT IN LBS
OZ0214 06JUL ICN/SFO HL7742
PAX 262/30/ 1 TTL293 CGO22706
CLS 0/21/271 CREW 2/ 1/11
SOW 325008U C.G PLD 68496
ZFW 393503 28.47 TO BAG
TOF 193200 STAB PCS 304
TOW 586703 28.41 WT10245
TIF-165499 TAXI WT
LDW 421204 587704 AGNTKIM HO

QU SELFAOZ
.BKKXCXA **060715**
A80
FI OZ0214/AN HL7742
DT BKK ICN 060715 M19A
- 3F02 WTBAL 0214/06 RKSI/KSFO .HL7742
/ACCEPT 707528
06JUL0715 AVN 284

QU SELFAOZ
.TYOJCXH **060849**
WXR
FI OZ0214/AN HL7742
DT JDL NGO1 060849 M23A
- 01 WXRQ 0214/06 RKSI/KSFO .HL7742
/TYP 1/STA UHMM/STA PANC/STA RJAA
06JUL0849 AVN 339

QU BKKIRXA
.SELFAOZ **060852** 33
CMD
AN HL7742
- QDSELFAOZ~1 WXRQ INFO
WEATHER INFO
CITY ONLY / UTC 06JUL 0851Z
UHMM/GDX-SOKOL/MAGADAN,RUSSIA
MET 06/0800Z 27001MPS 9999 FEW010 OVC028 15/13 Q1007 NOSIG (FR
LIDO)
06/0700Z 26001MPS 9999 SCT010 OVC026 16/13 Q1008 NOSIG (FR
TAF 06/0735Z 0609/0715 11004MPS 5000 -SHRA BR BKN007 BKN020CB O
VC100 530009 530906
TEMPO 0609/0618 2000 SHRA BR BKN004 BKN015CB OVC080 (FR LID
O)
PANC/ANC-ANCHORAGE INTL/ANCHORAGE,AK,USA
MET 06/0753Z 15010KT 9999 FEW025 BKN060 OVC080 12/07 A3003 (FR
06/0653Z 15012G19KT 9999 -RA FEW025 BKN060 OVC080 12/08 A30
03 (FR LIDO)
TAF 06/0532Z 0606/0712 15011KT P6SM -RA SCT025 OVC050
TEMPO 0606/0608 15015G22KT F M061300 VRB04KT P6SM SCT040 OV
C060
FM062300 16012G20KT P6SM SCT040 OVC070
FM070 600 17007KT P6SM VCSH SCT040 OVC060 (FR LIDO)
RJAA/NRT-NARITA/TOKYO,JAPAN
MET 06/0800Z 22015KT 190V250 9999 FEW025 BKN/// 30/23 Q1007WS R
16R WS R16L TEMPO 22018G30KT
06/0700Z 22022G34KT 9999 FEW030 BKN/// 30/23 Q1006 WSR16R W
S R16L NOSIG
TAF 06/0242Z 0603/0706 22016G27KT 9999 FEW020
TEMPO 0603/0610 22023G37KT
BECMG 0700/0703 23006KT
COA 06/0030Z RWY 16 IN USE

QU SELFAOZ
.QXSXMXS **061304**
WXR
FI OZ0214/AN HL7742
DT QXT POR1 061304 M24A
- 01 WXRQ 0214/06 RKSI/KSFO .HL7742
/TYP 1/STA KSFO/STA PANC/STA CYQQ
06JUL1305 AVN 806

QU BKKIRXA
.SELFAOZ **061308** 00
CMD
AN HL7742
- QDSELFAOZ~1 WXRQ INFO
WEATHER INFO
CITY ONLY / UTC 06JUL 1306Z
KSFO/SFO-SAN FRANCISCO INTL/SAN FRANCISCO,CA,USA
MET 06/1256Z 00000KT 9999 FEW010 SCT013 13/09 A2980 (FR LIDO)
06/1156Z 19006KT 9999 FEW010 SCT013 13/09 A2979 (FR LIDO)
TAF 06/1120Z 0612/0718 24005KT P6SM FEW012
TEMPO 0613/0617 BKN015
FM061800 29010KT P6SM FEW012
FM062200 28014KT P6SM FEW012
FM070700 27006KT P6SM FEW012
FM070900 26005KT P6SM BKN007
FM071600 23004KT P6SM FEW010 (FR LIDO)
PANC/ANC-ANCHORAGE INTL/ANCHORAGE,AK,USA
MET 06/1253Z 34003KT 9999 FEW030 BKN055 OVC080 12/09 A3000 (FR
LIDO)
06/1153Z 34007KT 9999 FEW030 BKN060 OVC080 12/09 A3001 (FR
TAF 06/1146Z 0612/0718 VRB04KT P6SM FEW030 OVC060 WS020/13030KT

TEMPO 0612/0616 -S HRA
FM061800 VRB04KT P6SM FEW030 OVC060
FM062300 16012G20KT P6SM OVC070
FM07060 0 17007KT P6SM VCSH OVC060 WS020/13040KT
FM071400 VRB06KT P6SM VCSH OVC050 WS02 0/13050KT (FR LIDO)
CYQQ/YQQ-COMOX/COMOX,CAN
MET 06/1200Z 30004KT 9999 SKC 12/09 A3001 (FR LIDO)
06/1100Z 31005KT 9999 SKC 13/09 A3001 (FR LIDO)
TAF 06/1139Z 0612/0712 32006KT P6SM SKC
FM061600 35010KT P6SM FEW040 RMK NXT FCST BY 061800Z (FR L
IDO)

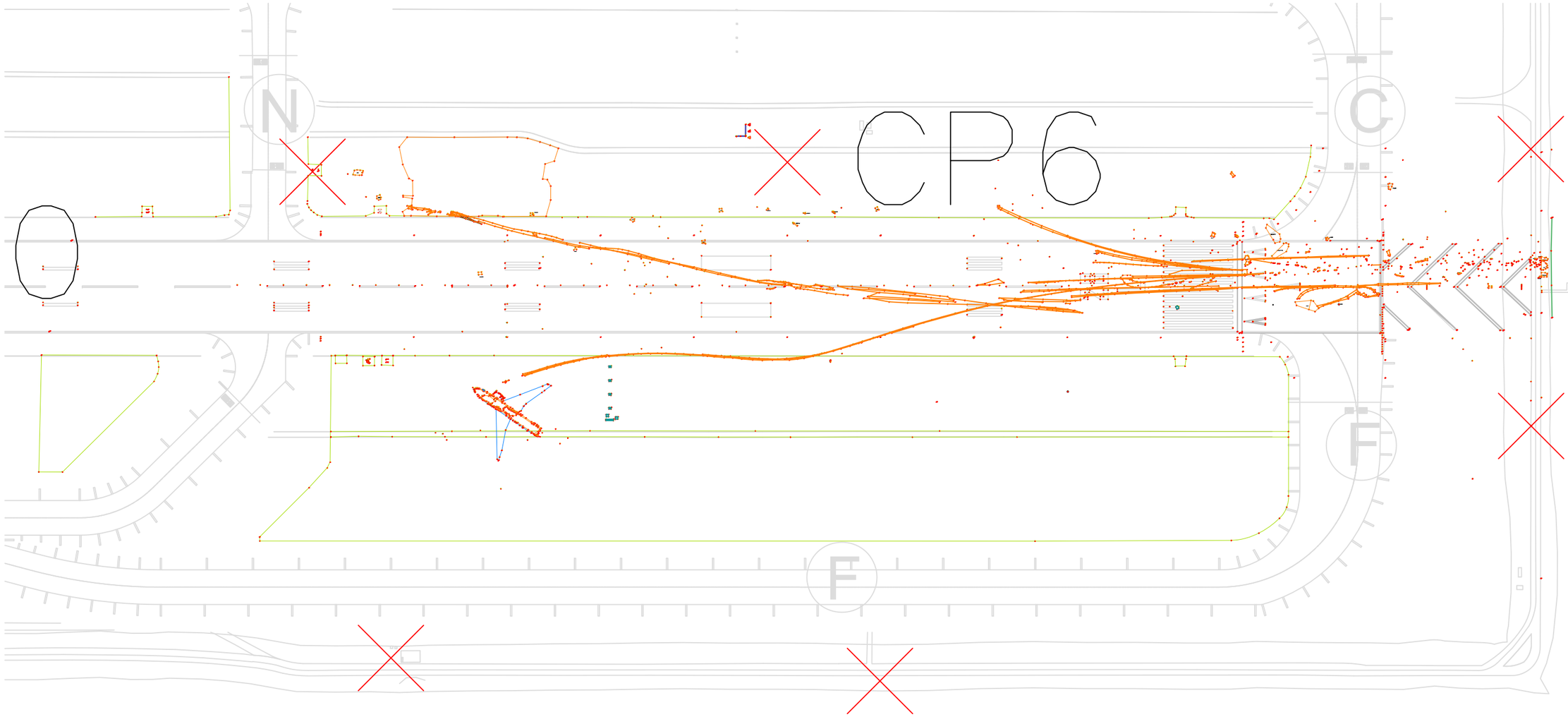
[사조위 요청자료] 항공기 정비/증빙/교육 관련자료

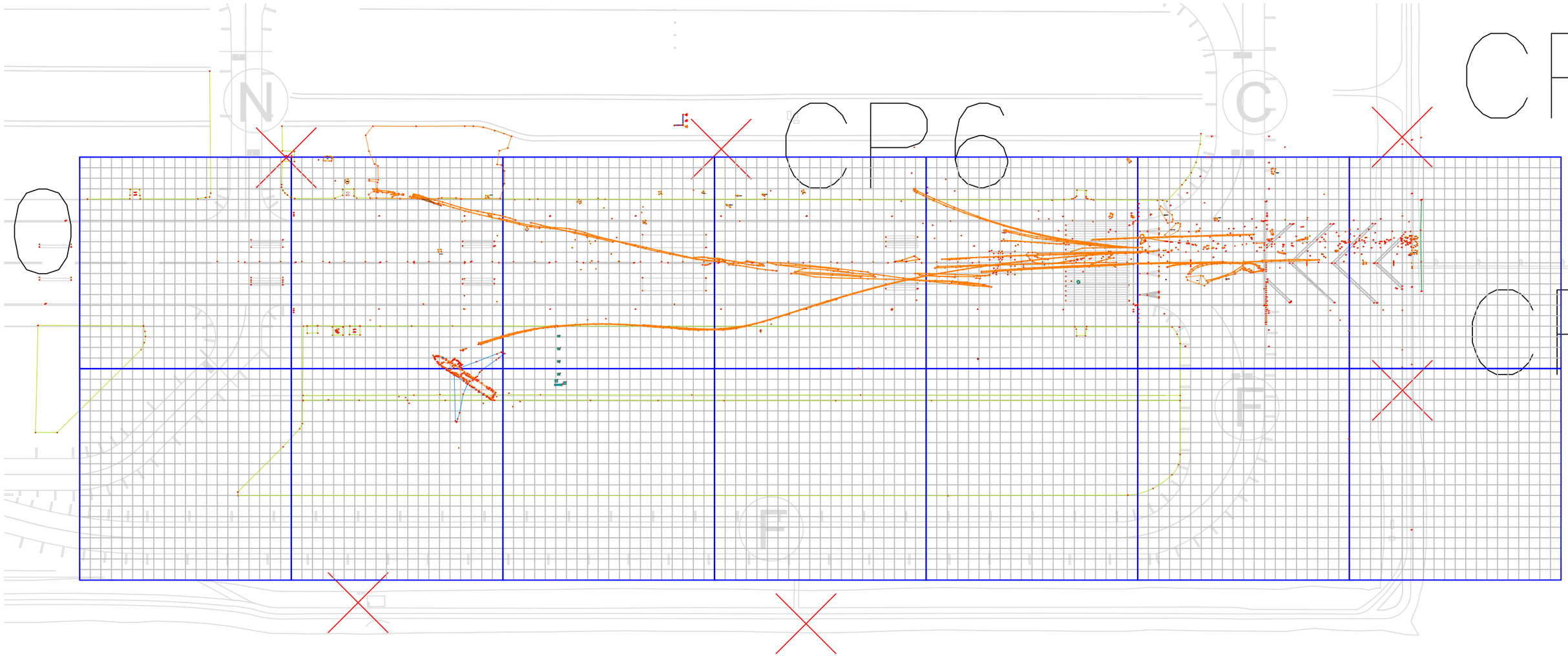
이용회

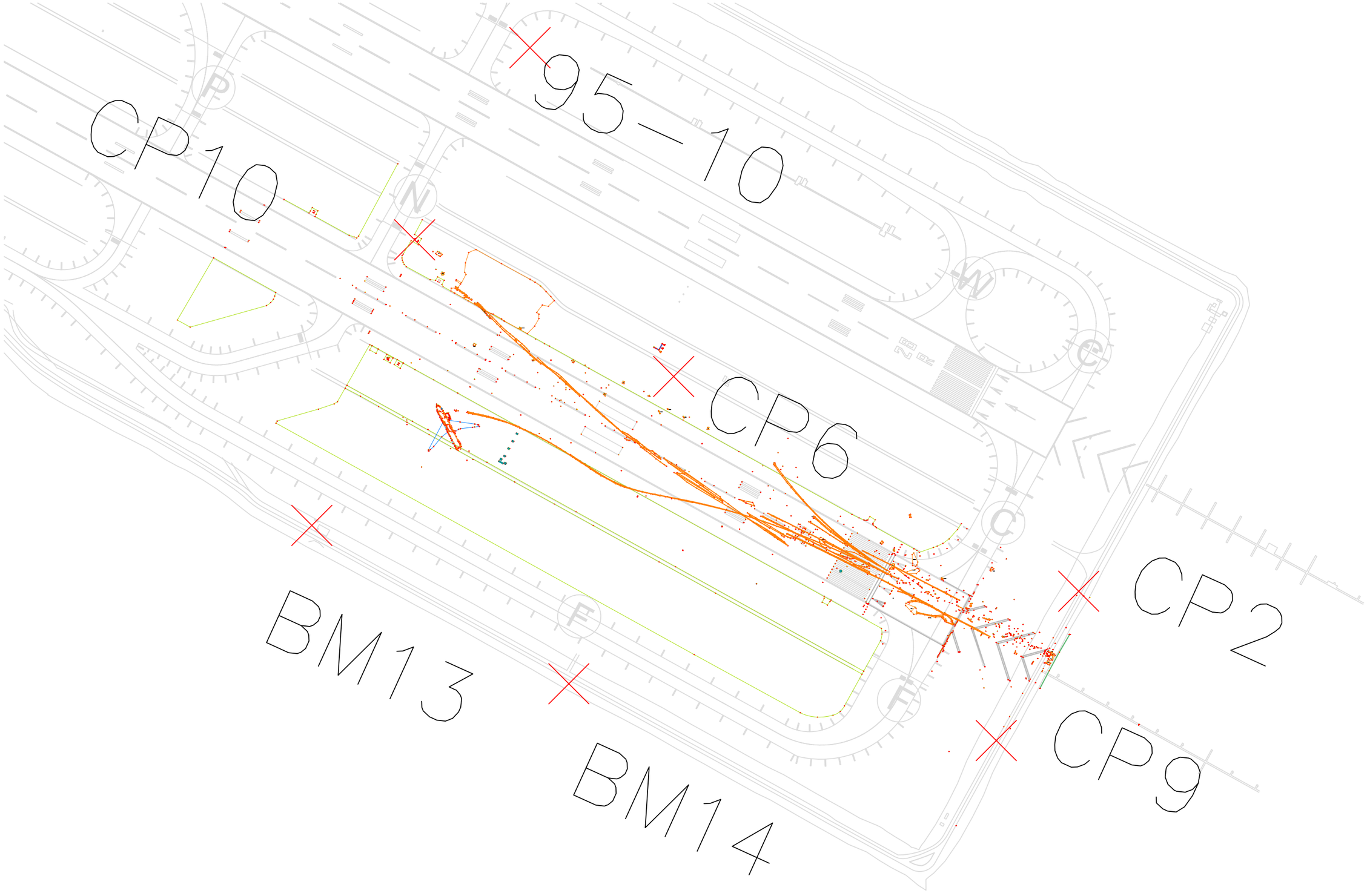
보낸 날짜: 2013년 7월 7일 일요일 오전 11:13
받는 사람: 민경민
Cc: 이우길; 김상순; 박은종; 황정욱; 윤상균; 이귀용; 노귀현

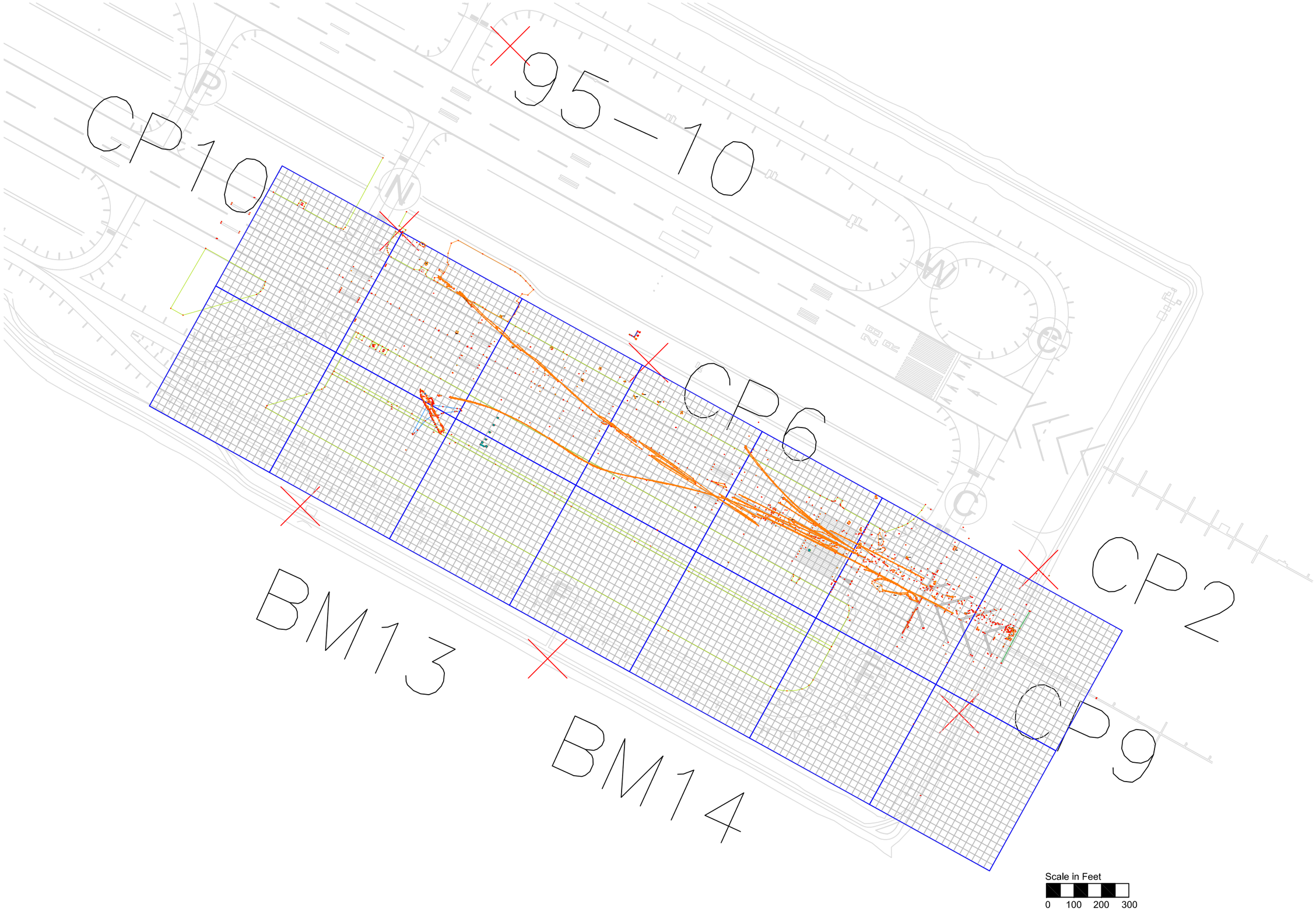
HL7742 항공기 2013년 7월 6일 OZ214(ICN/SFO)편 ACARS Data 관련 자료입니다.
항공기 비행중 Detection 된 결함은 없습니다.

Attachment 4: Accident Site Survey & Photograph Log


CP6
CP
CP
BM13
BM14
Scale in Feet
0 100 200 300


CP6
BM13
BM14
Scale in Feet
0 100 200 300


95-10
CP10
CP6
BM13
BM14
CP2
CP9
Scale in Feet
0 100 200 300


95-10
CP10
CP6
CP2
CP9
BM13
BM14
Scale in Feet
0 100 200 300

Asiana Flt 214 Performance Team
Photo Log from 8 July 2013
Author: R. Stoney, FAA (robert.stoney@faa.gov)
Notes:
1) This log describes photo taken during a survey of the crash site on 8 July 2013
2) "Photo Number" refers to the filename of photo taken (eg: "11" refers to photo with filename IMG_0011.JPG)
3) "Total Station #" refers to reference number from FBI team utilizing survey equipment in support of investigation
Gaps in the Total Station numbers indicate points that were surveyed without a photo.
A range of numbers typically indicates a series of points outlining or defining the shape/size of the object.
The notation "Center" indicates that the center of the object was surveyed, often at a different depth (eg: a gouge)
4) "Direction" is the direction (deg Magnetic; or cardinal direction) that the photo was shot facing.
5) "Description" includes dimensions. Some are in standard inche units (eg: 1/2") and some in DIGITAL inches (eg: 0.5)
"DNR" = Did Not Record

PHOTO #	TOTAL STATION	DIRECTION	DESCRIPTION
11	2072-2078	~N	2 Main Wheels
12	2065-2071	N	Tail Cone
13	2117-2121	~W	Vert Stab
14	2122	E	Single Main wheel/tire/brake
15	2093-2103	280	Main landing gear strut with 3 wheels and tires
16	2104-2110	100	Left Horizontal Stabilizer and Elevator
17	2111-2116	100	Right Horizontal Stabilizier and Elevator
18	2145-2148	N	Gouge (approx 2.4 ft long, 1.2ft Wide, 0.3-0.4" deep
19	2149-2150	S	Lateral Limits of dense debris field
20	2152	N	Section of Flap
21	2158-2167	N	Scrub (tire?) and Scrape
22	2168-2172	S	Scrape (~0.1" deep, 3.7" Long, 0.4" Wide)
23	2177-2178	S	Lateral Limits of dense debris field (fuselage scrapes?)
24	2179-2184	N	Scrape
25, 26, 27, 28	2185-2219	280	Large Scrape (#2 Nacelle?). Possibly a combination of #2 Nacelle and top of vertical stabilizer?
29	2220-2232 (Line)	W	Rudder Paint witness Mark (note: due to survey target being obscured from laser, could not survey last few feet (came back later and got it?)

30	2233-2241		W		Scrape
					2 Scrapes/paint witness marks (mapped as separate lines, Photo #30
	2242-2255 &				also shown on left of frame. Note: we ended survey at displaced
31 (32 is closeup)	2256-2268		W		threshold but scrapes continued.
	LUNCH BREAK				
					Possible tire mark (note: another one just east of this was surveyed,
33	2275-2279		S		Total Station #'s 2269-2274
34		2280		280	Center of aft pressure bulkhead
					Scrapes/scrubs (tire?) and 3 gouges. Gouge depth of (in frame) lower
					to upper: 3 ft, 5 ft, 6ft. Depth from Total Station #2290, 2291, 2292
35	2281-2289			280	respectively.
36		2293	~W		Gouge (center; depth about 2")
37		2291	~W		Gouge (center; depth about 2")
38	2292-2299		~W		Medium sized gouge
40	2301-2305		S		Aerodynamic surface--not identified
41	2306-2307			280	Lateral limits of multiple scrapes at first threshold
42	2308-2309			280	thin, shallow gouge
43	2310-2322			280	Large scrape mark
44	2324-2328		W		Shallow gouge (less than 1/2 inch)
45	2329-2332		S		Deep gouge (about 0.3"; depth shot as 2333)
46	2334-2337		N		Gouge (depth: 2338)
47	NONE		N		Singapore Airlines 777 landing (300ER?); note landing gear
48	2339-2344		S		Gouge (depth: 2345)
49	2346-2348		N		Gouge (depth 2349)
50	2350-2353		N		Gouge (Depth 2354
51		2355	S		Gouge (depth only…single point)
52	2356-2359		W		4 small gouges in a row
53	2360-2363		W		Shallow narrow gouges (two of them)
					shallow gouges (lower is 0.35 ft wide; upper is 0.15 ft wide). Less than
54	2364-2366		W		1/2 inch deep. Get length from Total Station
55	2320-2371		W		Centerline of multip light witness markes about 2 ft wide
56	2372-2376		W		Large gouge
57		2377	W		Large gouge
58	DNR		W		Large gouge (did not record Total Station number)

	59	2387-2388		DNR	Lateral limits of multiple scrape marks at displaced threshold
60, 61		2396-2399		S, W	Gouge with structure embedded
	62		2400	W	Large area soaked with oil, approx 10 meter diameter
	63		2401	N	Partial half of wheel (Nosewheel?)
	64	2403, 2404		S	2 large rocks
	65		2405	S	Medium rock
	66		2410	W	Gouge
	67	2419-2422		S	Piece of flap assembly
	68		2423	W	Gouge (center only)
	69	2424-2426		W	Gouge (center is 2426)
	70		2441	S	Auxiliary Power Unit
	71	2442-2463		280	Witness mark (double lines; total station outlined only the outside of the marks--i.e. no gap is surveyed, though the gap is clear.
	72	NONE		Looking dow	Closeup of typical section of witness mark from photo 71. Note tape measure for scale.
	73	NONE		280	Squiggly line, not surveyed, Kevin Renze says it looks like pre-existing seam in pavement.
	74	NONE		280	Same basic phgoto as #71 except with flags marking path.
	75	2464-2476		280	Section of brown colored witness mark 3 in wide. Line is in center of frame, to left is mark shot in picture #71
	76	2482-2510		280	Tan colored witness mark. Note galley cart, it is the point at which picture #77 was shot
	77	See previous		280	Continuation of photo #76 shot from location of galley cart discussed in notes for 76.
	78	See previous		280	Continuation of photos 76 and 77, shot from top of "2" in runway marking "28". End of mark is visible.
	79	NONE		Down	Closeup of witness mark shown in pics 75-78. Shot between the "28" and the "L" in runway marking of numbers. Approx 12 in wide
80, 81, 82, 83, 84		2511-2517		~080	Outline of main gear strut with 3 wheels and tires. Closeup of fracture points is shown in pics 82 and 83.
	85	2518-2530		~120	Witness mark leading to Lower Portion of Main Strut

86	See above		~100		Continuation of witness markes shown in photo 85. Time 1603
87	NONE		Down		Closeup of damage to recessed runway light
88		2533	DNR		Divit in pavement; continuation of witness mark from photo 85 and 86 (same path, just bouncing?)
89		2534	DNR		Same as photo 88, continued
90		2535	DNR		Same as photo 88, continued
91	2536-2540		DNR		Witness mark leading to upper portion of main strut
92		2541	DNR		Single Main wheel/tire/brake
93	2542-2546		DNR		Double maint wheel/tire/brake with axle
94	NONE		DNR		Closeup of fracture (appears to be related to pics 80-84
95	2547-2567			280	Tan witness mark leading up to Galley assembly (outline)
96	NONE			100	Closeup of galley assembly from photo 95
97	None			100	Looking back down witness mark from Photo 95
98		2570	DNR		Large Rock
					DONE IN FIELD; Time 1700

Asiana Flt 214 Performance Team
Photo Log from 9 July 2013
Author: R. Stoney, FAA (robert.stoney@faa.gov)
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5) "Description" includes dimensions. Some are in standard inche units (eg: 1/2") and some in DIGITAL inches (eg: 0.5)
"DNR" = Did Not Record

PHOTO #	TOTAL STATION #	DIRECTION	DESCRIPTION
99, 100	2631-2642; 2643-2661	~260 deg	Purple/White and Red witness marks leading to base of Vertical Stab/Aft Fuselage Assembly. Photo #100 is closer to assembly.
101	2591-2630	~300 deg	4 outlines of tan witness mark
102	None	N	APU and Threshold lights (note: closest and farthest lights are broken, apparently by mishap aircraft)
			PHOTOS 103-106 deleted
107	2664	280	Spare Tire/Wheel
108	2665-2669	280	Safter Galley Floor (requested by Interiors group)
109, 100, 111	2670-2680	~W	Photos progress to west along line. Continuation of approx 1 ft wide witness mark. Double line, line shown to left in photo is narrower than right line. Marks end at vertical flag in photo. Started survey at beginning of Displaced Threshold
112, 113, 114, 115, 116, 117, 118, 119, 120, 121	2681-2705; 2706-2709; 2710-2717; 2718-2724; 2733-2736	~300	Witness mark leading to Galley Assembly off right side of runway (probable aft galley). Series of photos walking from origin of line to galley assembly. Photo 117 is broken runway edge light. Photo 120 is portion of galley assembly, Photo 121 is other portion of assembly with Flight Attendant seat on right of ass'y. The marks were surveyed as an outline but consists of multiple narrow lines. The number of lines varies along the course of witness mark until past runway edge light, then lines appear to broaden and merge. 2718-2724, 2706-2709, 2710-2717 were additional short line segments possibly related. TOTAL STATION #2733-2736 is outline of assembly.
122	2708	~100 deg	Square metal piece is at Total Station 2708.
123, 124, 125	2725-2732	280 deg	Tan witness mark leading to right main gear door. Note that beginning of line was not distinct due to multiple lines in area east of displaced threshold. In picture #124 the dark/broad line appears (repeat: appears) to lead to Gear BUT the line extends well past gear (this mark was captured in points: TBD)
126	2737-2744	280	Aft Galley asembly (outlined). Note this galley ass'y was photo'd on 7/8/13, Photo # TBD.
127, 128, 129, 130	2745-2760	see notes	Long tan witness mark, outlined. Photo details: 127 shot at west end of mark looking east (small patch not surveyed?); 128: walking to east about 25 m from prior photo, photo captures where mark narrows down; Photo#129 taken while standing on "top" of the "8" (runway number 28) looking east. Survey stopped at middle of 8 but believed to continue east (Nacelle?). Photo #130: looking west, from about top of the "8".
131	2761	~N	Small rock
132, 133, 134, 135, 136, 137	2762-2787	see notes	Photo directions for 132 thru 137 are (respectively): 280/100/100/DOWN/100/W. Witness Mark possibly connected to 2745-2760 survey. Photos 132 and 133 shot from top of Right main gear ("top" meaning the top of the ass'y, which lay to the east) but they are in opposite directions. #134 shot from top of white strips at runway start, shot from the 7th strip from north foul line (not including foul line itself). #135 is looking down at typical mark. #136 shows mark progressing from debris path in under-run area. #137 is lookin gback up the line towards the Rt Main gear, in flight path direction.

138, 139, 140, 141	2788-2798	see notes	Photo directions fo 138 thru 141 are (respectively): E/DOWN/DOWN/W; Series of score markes (skipping object?). #139 is photo looking down on typical mark. #140 is another (width is ~27-28"). Slightly different (double).
142	2799, 2800	DOWN	2 small gouges
143	2806-2810 and 2811-2814	DOWN	2 gouges. Note: several gouges in this general area.
144	2876-2883	~260 deg	Series of 10 skip marks, appear to lead to loos tire/wheels
145	None	S	Tire witness marks
146	2865-2875	280	Area of witness marks (possible fuselage?). Contact west of displaced threshold. Diminishes as it goes west and appears to end in the vicinity of the western end of the runway stripes.
147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164	2884-2958	See notes	Eastern portion of apparent nosewheel witness marks. Western portion "shot" by other FBI team. Photos of western portion are available. Photo notes: #147 shot facing west at start of witness mark (diverging from rest of scrapes in the initial portion of the runway past displaced threshold; not that the nosewheel likely was in contact with the ground prior to this point, we just couldn't see a distinct mark indicating where it was east of this point); #148: shot adjacent to Right Main Gear truck; #149: Just short of triple IFR hash marks; #150: looking DOWN on mark @ west end of triple IFR hash marks; #151: Look down ~1/2 way from photo 150 to 152; #152: abeam light; #153 view "down-line" to west; #154: view down, abeam the "1" board for Rwy 09R; #155: view looking down where the nosewheel appears to have--for the first time--left pavement off the left side of 28L; #156: view along (note: shallow and deep burrows exist in this area; we outlined the shallow; plan to get the deeper gouge next day as separate survey); #157: looking back to the east. Note that TOTAL STATION point #2921 is where left side of tire re-enters pavement (recommend "stitching" this with group surveying western portion); #158: overview looking east; #159: view to west from end of our team's points. (we did not survey the skid in this pic at this time; plan to do 7/10); #160: 2 areas of dirt that appear to have been thrown onto pavement from action of object creating trench; #161: looking south, view of gouge in pavement on old pad (possibly for distance remaining); #162: view ~060 deg, looking back down line, note waviness of line's edge; #163: view ~060 deg, abeam windsock; #164: ~060 down the mark, note that witness mark becomes much less distinct (note: closeout point forms triangle at start of line because th emark is not clearly defined as it enters an area of significant scraping (fuselage?)
165	2959-2972	280	Witness mark (outlined--see photo for nature of marks)
166	Same as 165	DOWN	Closeup view of typical portion of mark shown in photo #165. Shot from the upper left of "2" on "28" runway marking.
167	2973-2974 & 2975-2976	W	2 line segment witness marks near or in 2959-2972 area. Alignment off about 5-10 deg from other surrounding witness marks.
168, 169, 170, 171, 172	2978-?	W	Area of multiple striated witness marks. The area of the witness marks is fairly large and is a "double Fan" shape--meaning that a fan of striated marks tapers into a narrow area and then widens back out again into another fan. The basic alignment of the centerline of the fans is approximately down Rwy 28L. The fans will be called "East Fan" and "West Fan". The first survey outlined the entire area of both east and west fans. Then, in the east fan, several of the striations were marked as lines--note that not ALL lines were captured, only enough to give a representation of the striation pattern. Similar striations were noted in the west fan as well, except these striations were curved (arcs) and were surveyed as such (again, not ALL arcs were surveyed but enough to give the sense of the pattern). Photo notes: #169: shot from narrow portion of mark, looking west; #170: west fan (note arcs); #171: looking south, a mark that is an exception to the striation pattern observed in the rest of this formation, this mark is in the vicinity of TOTAL STATION 2996.; #172: closeup view near narrow portion of formation, still in east fan.
173	3036-3040	E	Area of scuff marks
174	3041-3042	~260	Witness mark ~3" wide
also 174	3042-?	DNR	Gouge/swath appears to lead intotop of trench, 6" wide.
also 174	3048-?	DNR	Southern top of trench.

Asiana Flt 214 Performance Team
Photo Log from 10 July 2013
Author: R. Stoney, FAA (robert.stoney@faa.gov)
Notes:
1) This log describes photo taken during a survey of the crash site on 10 July 2013
2) "Photo Number" refers to the filename of photo taken (eg: "11" refers to photo with filename IMG_0011.JPG)
3) "Total Station #" refers to reference number from FBI team utilizing survey equipment in support of investigation
Gaps in the Total Station numbers indicate points that were surveyed without a photo.
A range of numbers typically indicates a series of points outlining or defining the shape/size of the object.
The notation "Center" indicates that the center of the object was surveyed, often at a different depth (eg: a gouge)
4) "Direction" is the direction (deg Magnetic; or cardinal direction) that the photo was shot facing.
5) "Description" includes dimensions. Some are in standard inche units (eg: 1/2") and some in DIGITAL inches (eg: 0.5)
"DNR" = Did Not Record

PHOTO #	TOTAL STATION #	DIRECTION	DESCRIPTION
184	5177	~300 deg	Scoring in Dirt off right side of runway, leading up to #1 engine. TOTAL STATION #5177 is just one # used in outlining several marks in this area. With different ERT team than day before (this team: Mike, Ian, Greg)
185, 186	5195-5200	W	Engine Cowl ring, other pieces in area not surveyed but general view shown in Photo #186.
187	See notes	~110	TOTAL STATION reportedly done on 9 July 2013. Multiple witness marks back from where #1 engine came from. Note metal strip at top of this picture as a reference point for next picture.
188	See notes	~110 deg	Continuation of #187; shot in same direction, shot from metal strip in top of #187
189	5201-6	N	Engine cowling
190	5207-5210	280	piec of Thrust Reverser
191	5211-13	280	Engine tailpipe
192	none	~110	Continuation of witness mark from photo #187 & 188
193	none	~110	Continuation of witness mark from photo #187 & 188
194	none	DOWN	Section detail of witness mark
195	none	~320	View back towards engine, along witness marks. Taken from same point as photo #193.
196	5219-5223	N	Fan cowl? Part Number: 314W3085-45, Ser 232. CANON CAMERA battery runs out; switch to iPhone
2736	5224-27	N	FIRST iPHONE PICTURE ON THIS LOG. Cowl piece w/actuator attached.
2737, 2738	5228-30	N	Flap fairing; 2nd photo shows closeup of written description left by other team member
2739	TBD	~120 deg	Main landing gear beam, reportedly surveyed before.
2740, 2741	5231-5233	DNR	Flap fairing; 2nd photo shows closeup of written description left by other team member
2743, 2744	5234-5238	N	Flap fairing; 2nd photo shows closeup of written description left by other team member
2745	5239-5242	N	Engine cowling about 5m off right side of Rwy 28L
2746	TBD	~300 deg	Possible engine impact point after being flung off left wing (ref: video)? Reportedly surveyed on 7/9
2747	DNR	N	Fan blade, typical
2748	DNR	~020	"Field" of scattered fan blades.
2750	5253-5257	DNR	Impression in earth, in between trench and nose strut engine location. Not clear if this is accident related. Last point (5257) is depth.
See previous days log	5258-5269	DNR	Centernline thru trench is shot;
2779	3167-3187	280 deg	Additional witness mark in area of suspected #1 engine touchdown point. Marks begin to "skip". Approx 9 skip marks, each ~6-12" long and 3-7" wide. Skip marks appear to be an off-white color.

2780	3188-3194	280	witness mark. Gouge in about the middle of the witness mark is 2.5 ft long, 3" wide, ~2" deep.
2774	From yesterday	100	Nosewheel witness mark shown re-entry to pavement and then exit pavement for 2nd time.
2776, 2777	From yesterday	DNR	Last section of NW trench near aircraft

Asiana Flt 214 Performance Team
Photo Log from 11 July 2013
Author: R. Stoney, FAA (robert.stoney@faa.gov)
Notes:
1) This log describes photo taken during a survey of the crash site on 11 July 2013
2) "Photo Number" refers to the filename of photo taken (eg: "11" refers to photo with filename IMG_0011.JPG)
3) "Total Station #" refers to reference number from FBI team utilizing survey equipment in support of investigation
Gaps in the Total Station numbers indicate points that were surveyed without a photo.
A range of numbers typically indicates a series of points outlining or defining the shape/size of the object.
The notation "Center" indicates that the center of the object was surveyed, often at a different depth (eg: a gouge)
4) "Direction" is the direction (deg Magnetic; or cardinal direction) that the photo was shot facing.
5) "Description" includes dimensions. Some are in standard inche units (eg: 1/2") and some in DIGITAL inches (eg: 0.5)
"DNR" = Did Not Record

PHOTO #	TOTAL STATION #	DIRECTION	DESCRIPTION
2783	TBD	280 deg	Gouges Abeam where tail section ended up. Not sure if photographed before. NOTE: this photo taken after cleanup of runway, removal of debris and wreckage.
2784	TBD	East	Witness mark. On original runway threshold at broad swatch (Left Nacelle? Brush from cleanup?). When follwed east to it's end, it "hooked" to the south…after much discussion we agreed it was likely NOT caused by accident aircraft. NOTE: this photo taken after cleanup of runway, removal of debris and wreckage.
2786	TBD	S	View of witness mark with small (~15") gouge. Appears to be on total station diagram. It was approx half way up on the right side of 2nd chevron, half way out the chevron on the right side of chevron. NOTE: this photo taken after cleanup of runway, removal of debris and wreckage.
2787	TBD	DNR	Witness mark (shot on TOT STAT as several Left and Right points) ***Need to fill in total station as an outline. NOTE: this photo taken after cleanup of runway, removal of debris and wreckage.

2788	TBD	330 deg True	Unusual gouge/witness mark combination--unusual because of alignment. Alignment is ~330 deg Tur, with is about 45-50 deg to the right of the apparent a/c path. Believe this was surveyed by TOTAL STATION as points (not outlined). NOTE: this photo taken after cleanup of runway, removal of debris and wreckage.
2789	TBD	263 deg True	Another witness mark off the axis of apparent path (this one is to the left relative to path). Doesn't appear to have been surveyed. NOTE: this photo taken after cleanup of runway, removal of debris and wreckage.
2793	TBD	S	Area of apparent a/c re-touchdown following spin. Appear to NOT have been surveyed. Outline of it was measured using a hand-held GPS (by Brian) and by Stoney using an iPhone APP (data sent to FBI ERT).
2795	TBD	E	View of same area (refer to notes from Photo #2793) taken from top of backhoe--good view of shape of disturbed area.
2796	TBD	N	Rut just west of PAPI light area. Surveyed by both Stoney (iPhone) and Brian (Garmin GPS)
2797	TBD	N	Impression in dirt, approx 5-10 ft in diameter, slightly oblong. Not surveyed by Stoney using iPhone. Was surveyed by Brian using Garmin GPS.

Attachment 5: Flight Data Recorder (FDR) Data

FIGURE A5.1: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH [LONGITUDINAL]

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

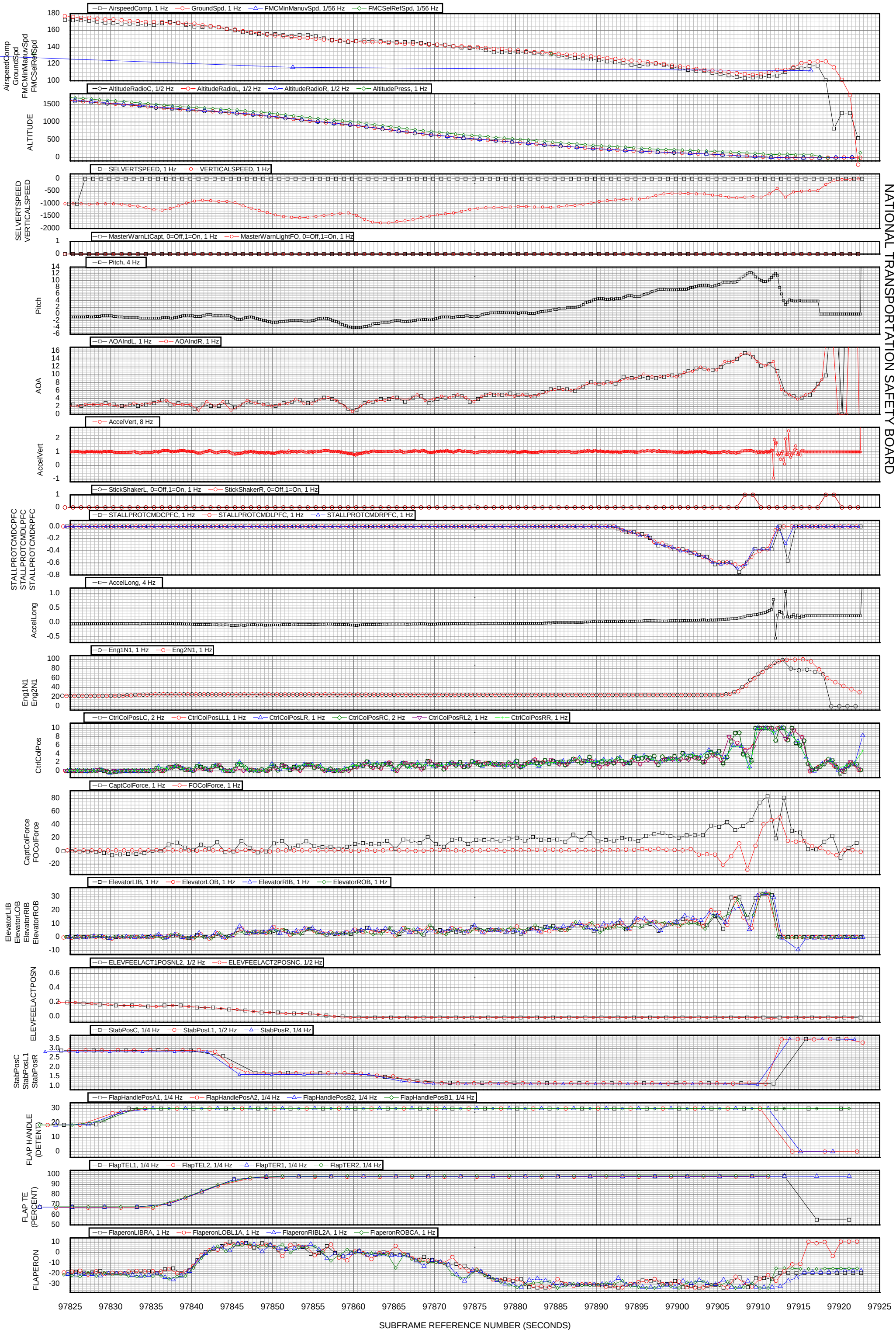

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FIGURE A5.2: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

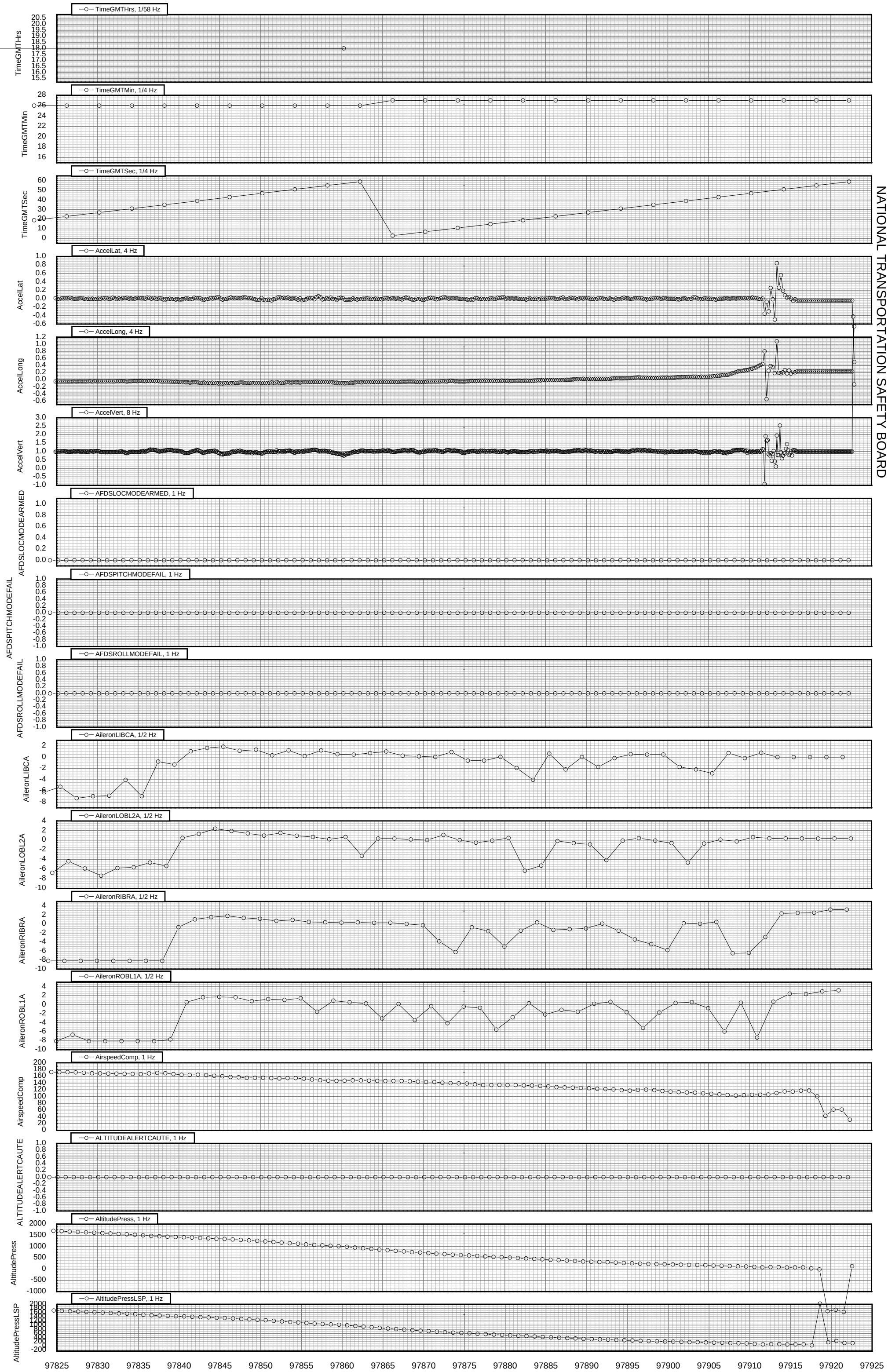

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FIGURE A5.3: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

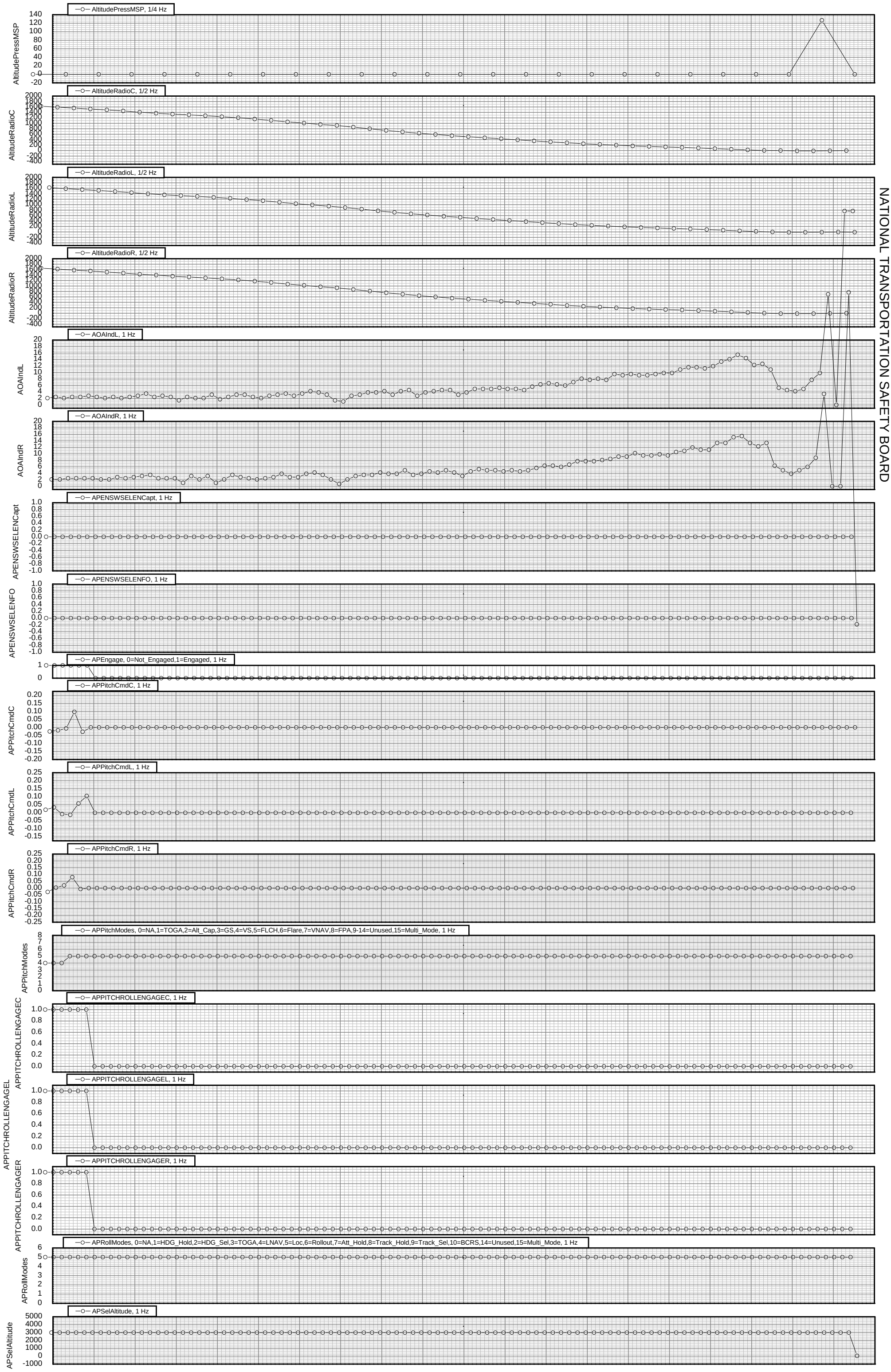

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FIGURE A5.4: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

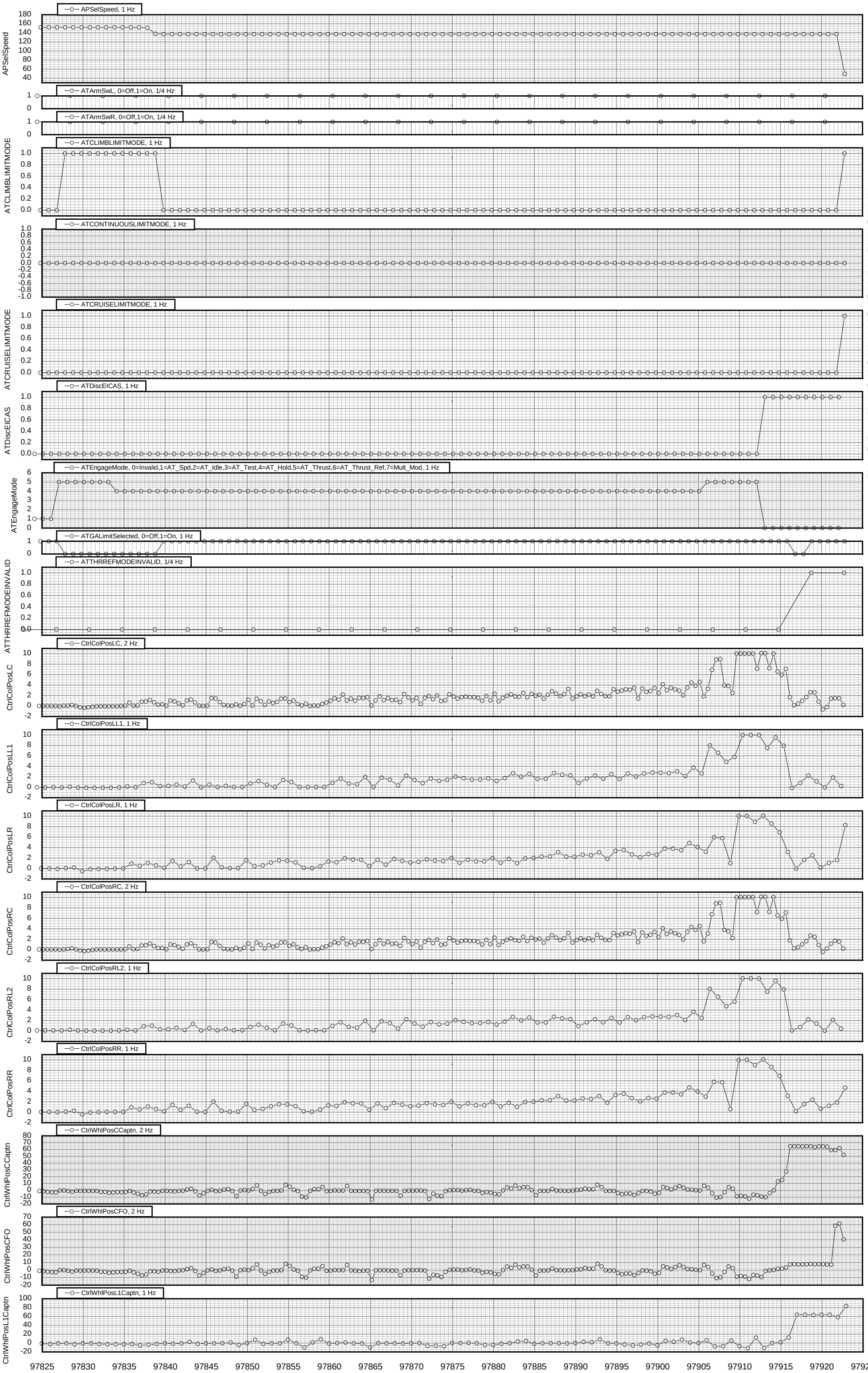

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FIGURE A5.5: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

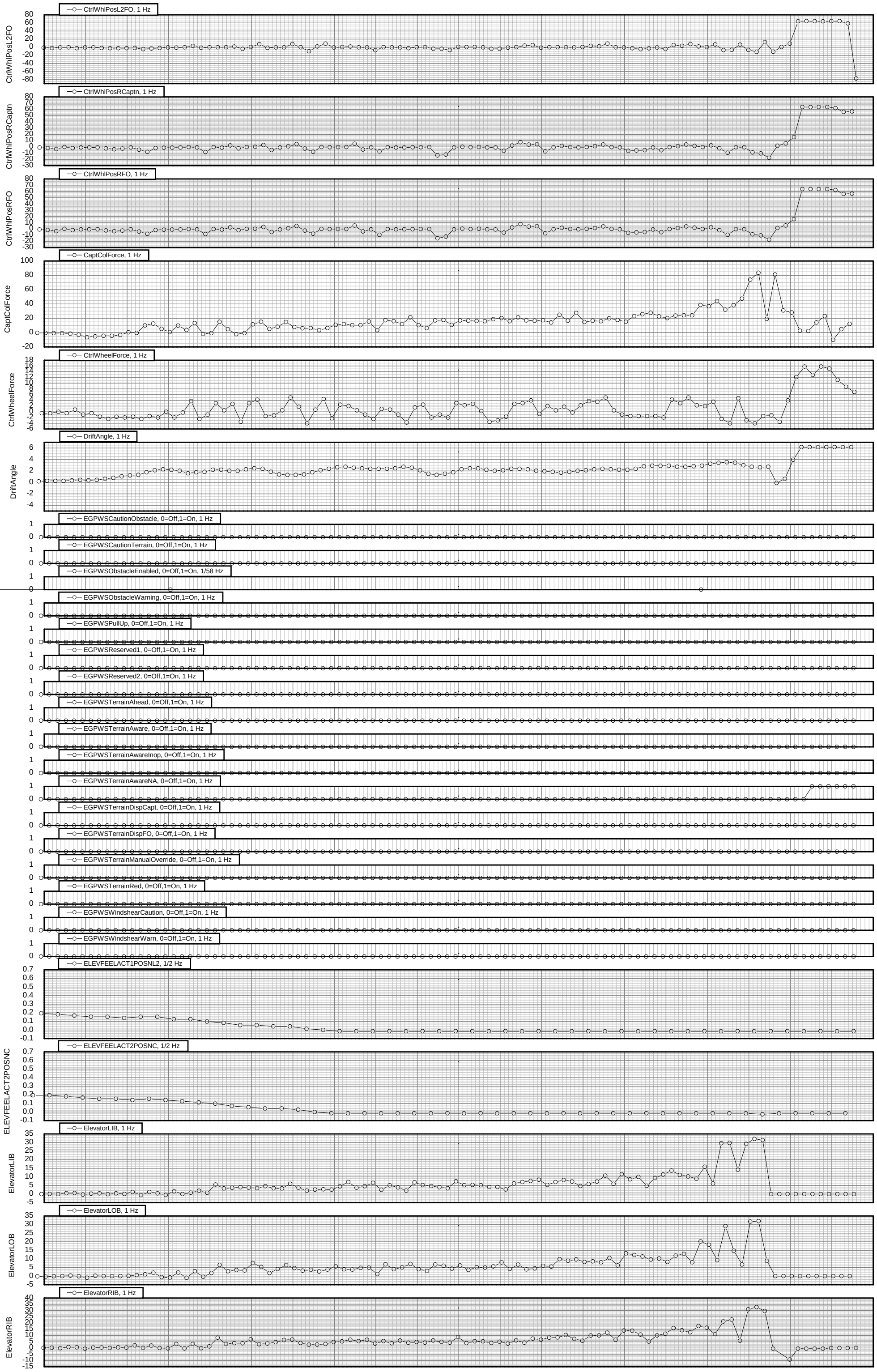

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FIGURE A5.6: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

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FIGURE A5.7: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

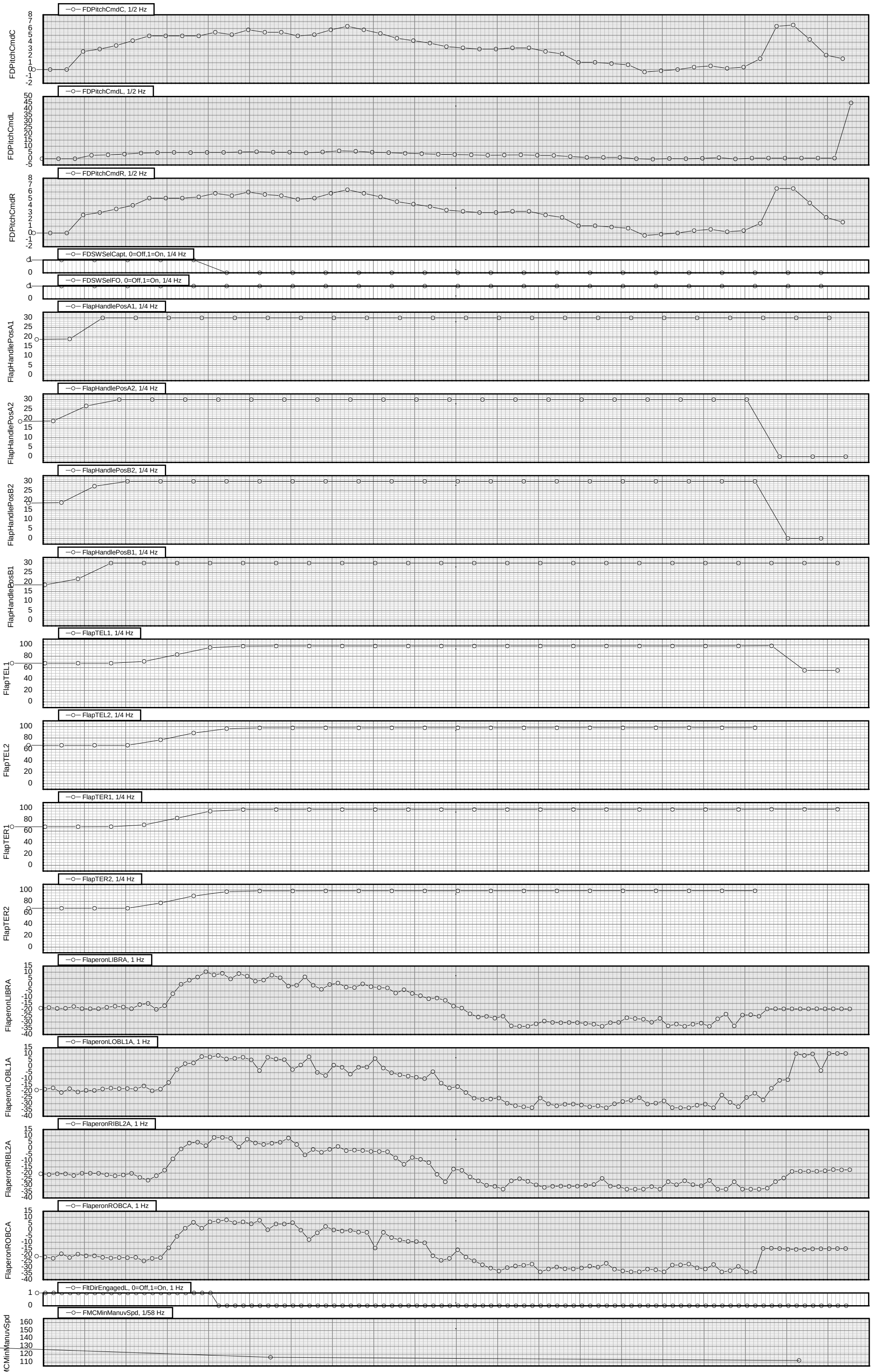

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FIGURE A5.8: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

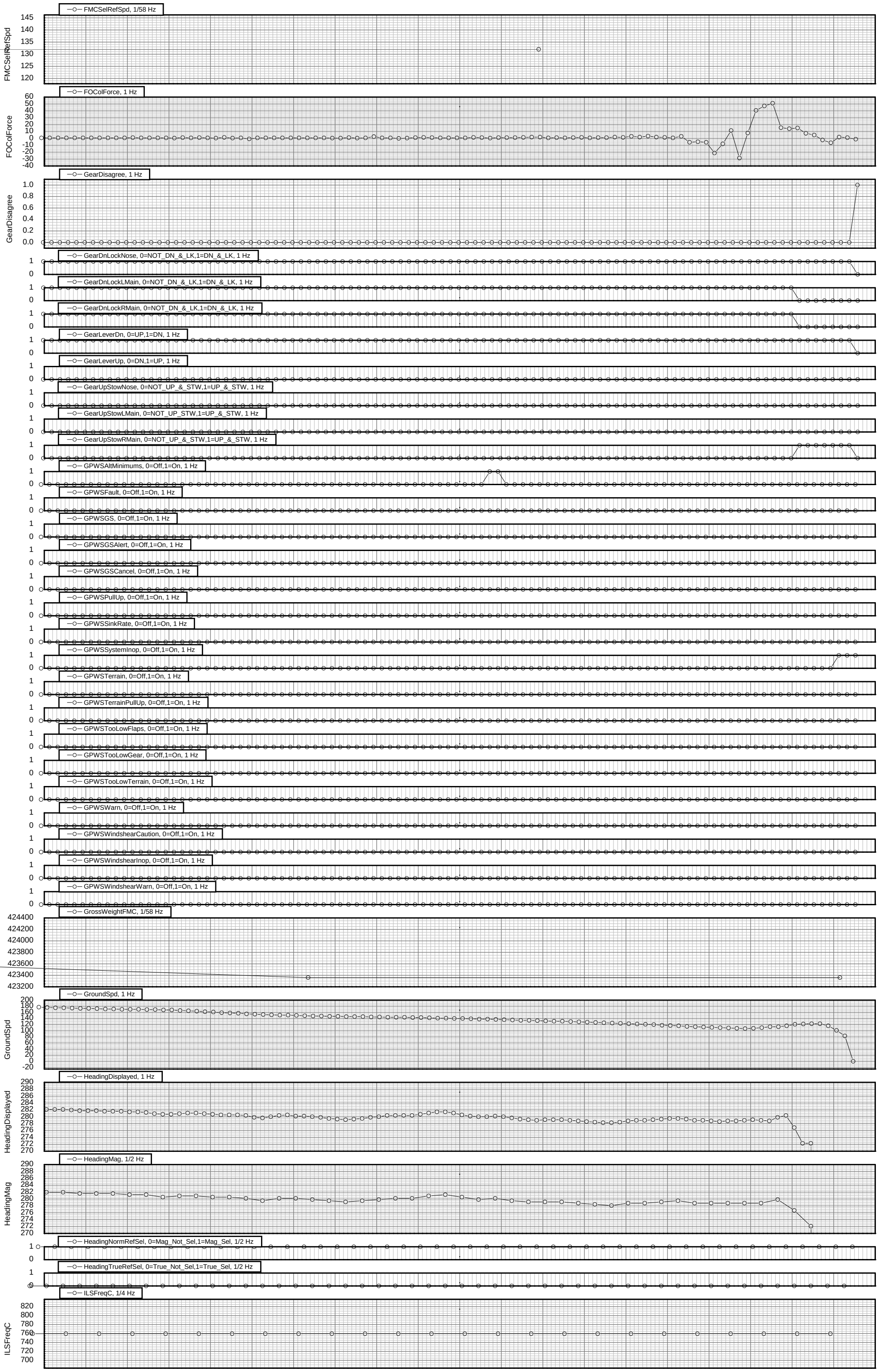

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FIGURE A5.9: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

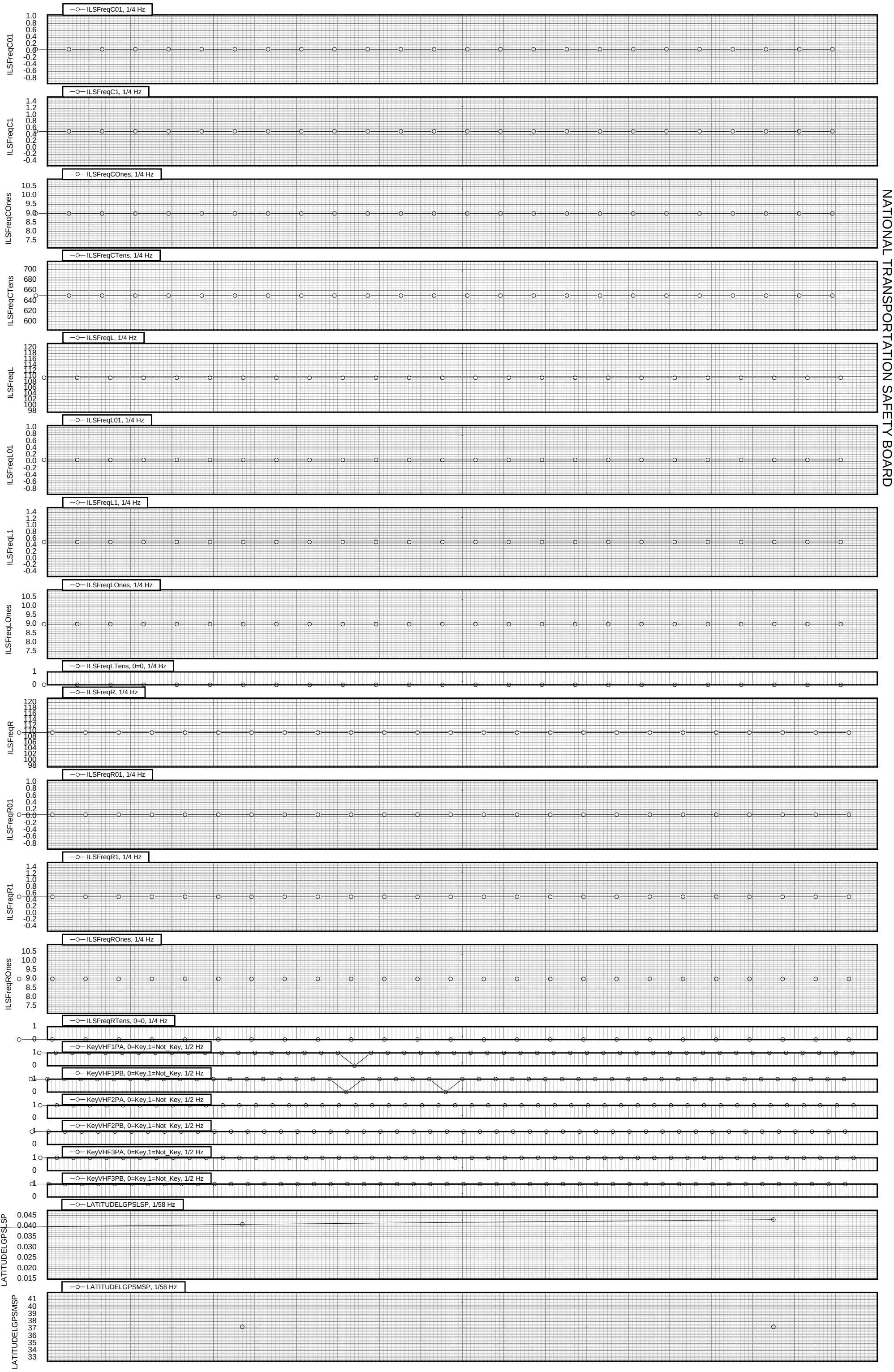

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FIGURE A5.10: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

LATITUDERGPSLSP, 1/58 Hz

LATITUDERGPSMSP, 1/58 Hz

LocDeviationC, 1/2 Hz

LocDeviationL, 1/2 Hz

LocDeviationR, 1/2 Hz

LONGITUDEGPSLLSP, 1/58 Hz

LONGITUDEGPSLMSP, 1/58 Hz

LONGITUDEGPSRLSP, 1/58 Hz

LONGITUDEGPSRMSP, 1/58 Hz

MasterWarnLightFO, 0=Off,1=On, 1 Hz

MasterWarnLtCapt, 0=Off,1=On, 1 Hz

MCPSpdDispBlnk, 0=Not_Blank,1=Blank, 1 Hz

Pitch, 4 Hz

Roll, 2 Hz

RudderPedPosCA, 1/2 Hz

RudderPedPosL1A, 1/2 Hz

RudderPedPosL2A, 1/2 Hz

RudderPedPosRA, 1/2 Hz

RudderLRA, 1/2 Hz

97825 97830 97835 97840 97845 97850 97855 97860 97865 97870 97875 97880 97885 97890 97895 97900 97905 97910 97915 97920 97925

SUBFRAME REFERENCE NUMBER (SECONDS)

NATIONAL TRANSPORTATION SAFETY BOARD

FIGURE A5.11: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

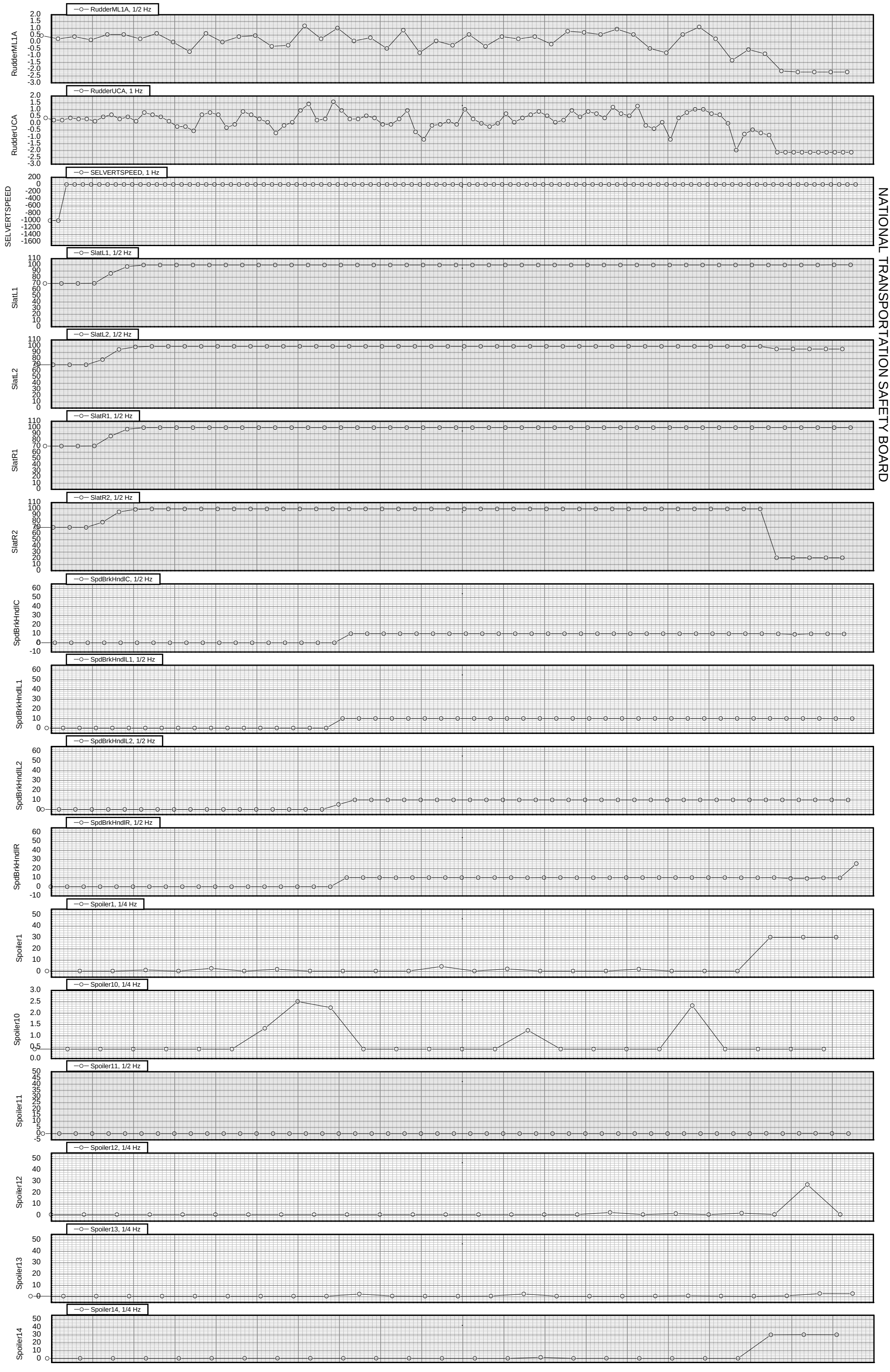

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FIGURE A5.12: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

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FIGURE A5.13: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

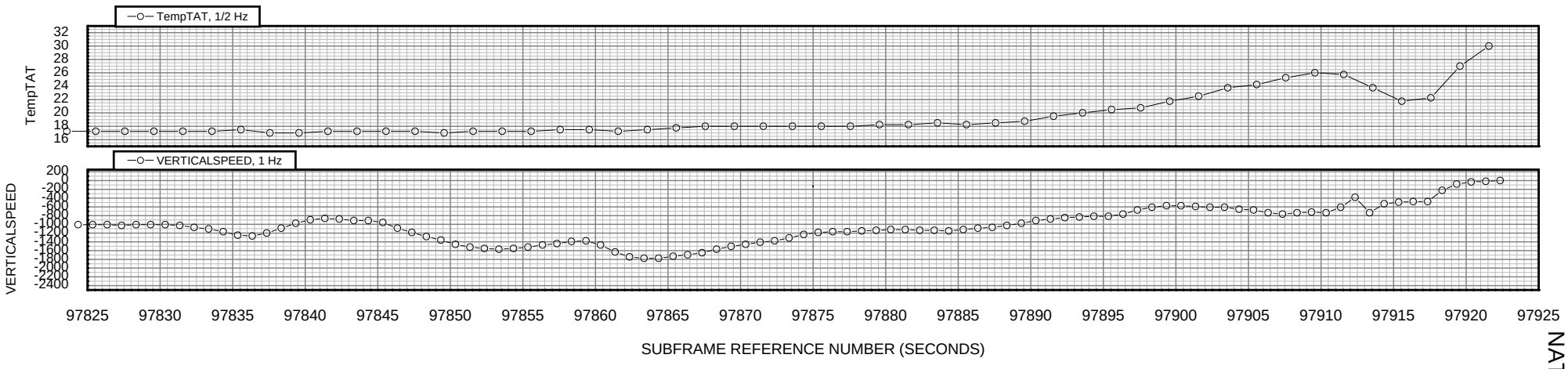

FIGURE A5.14: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH [LONGITUDINAL]

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

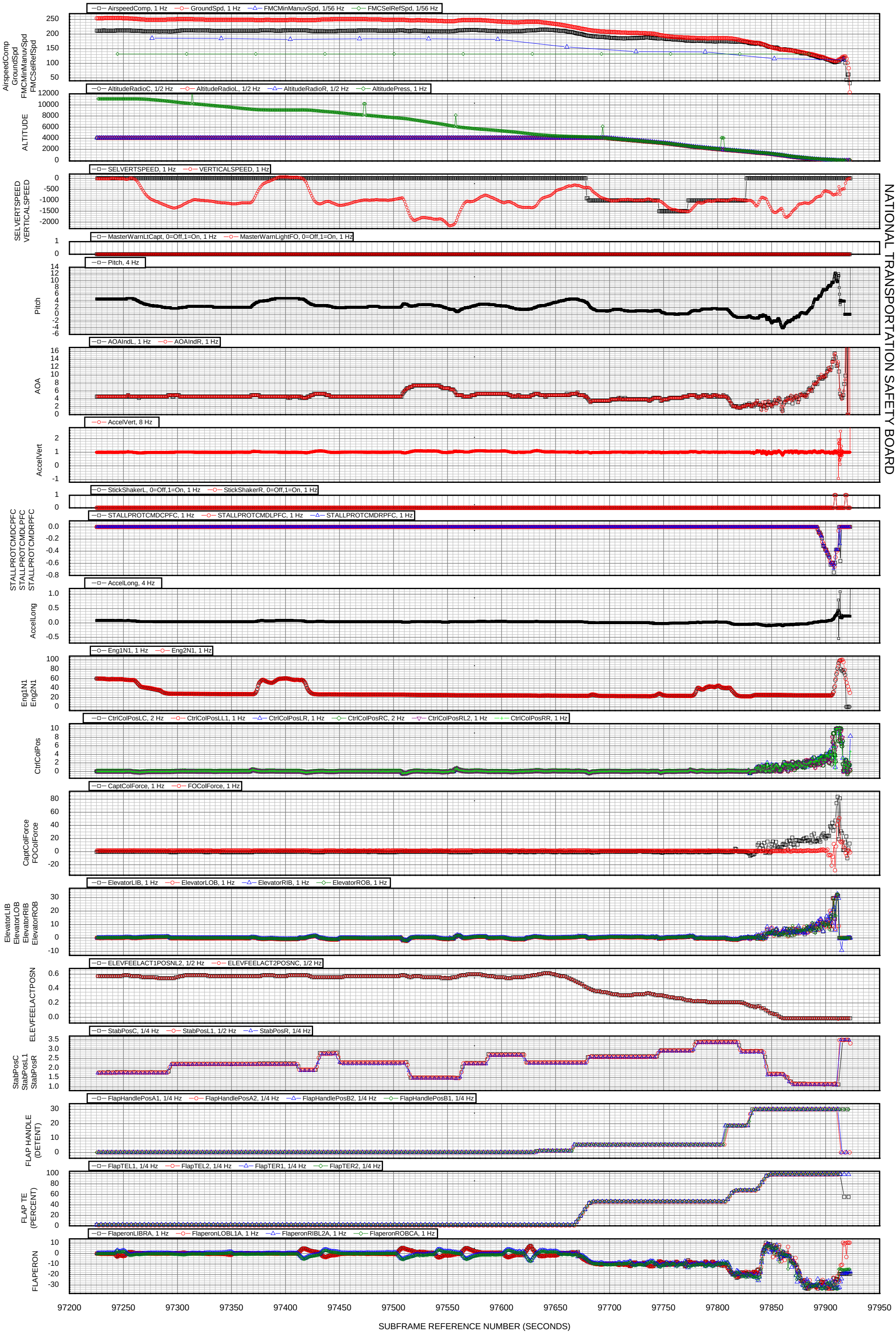

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FIGURE A5.15: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

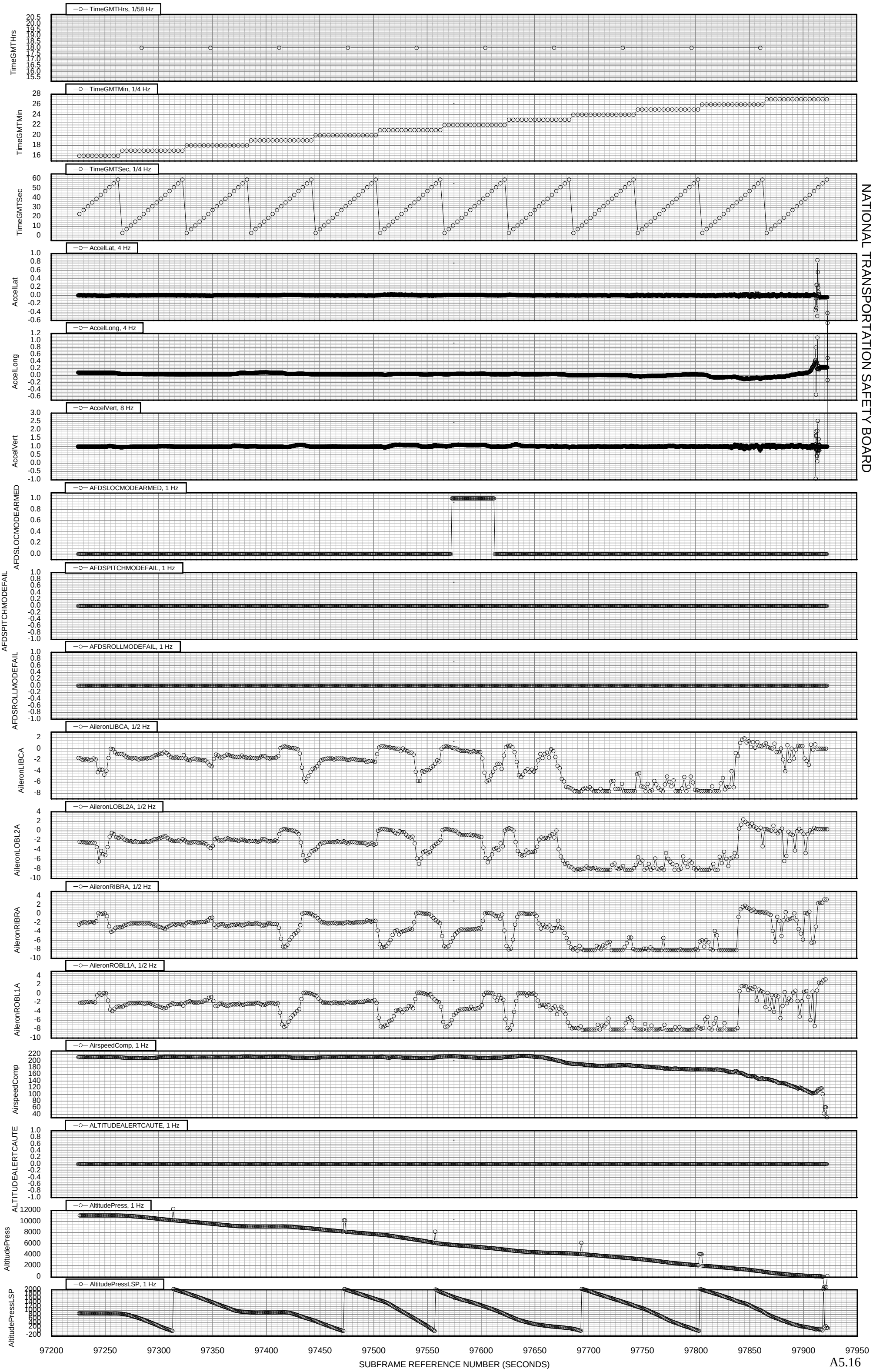

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FIGURE A5.16: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

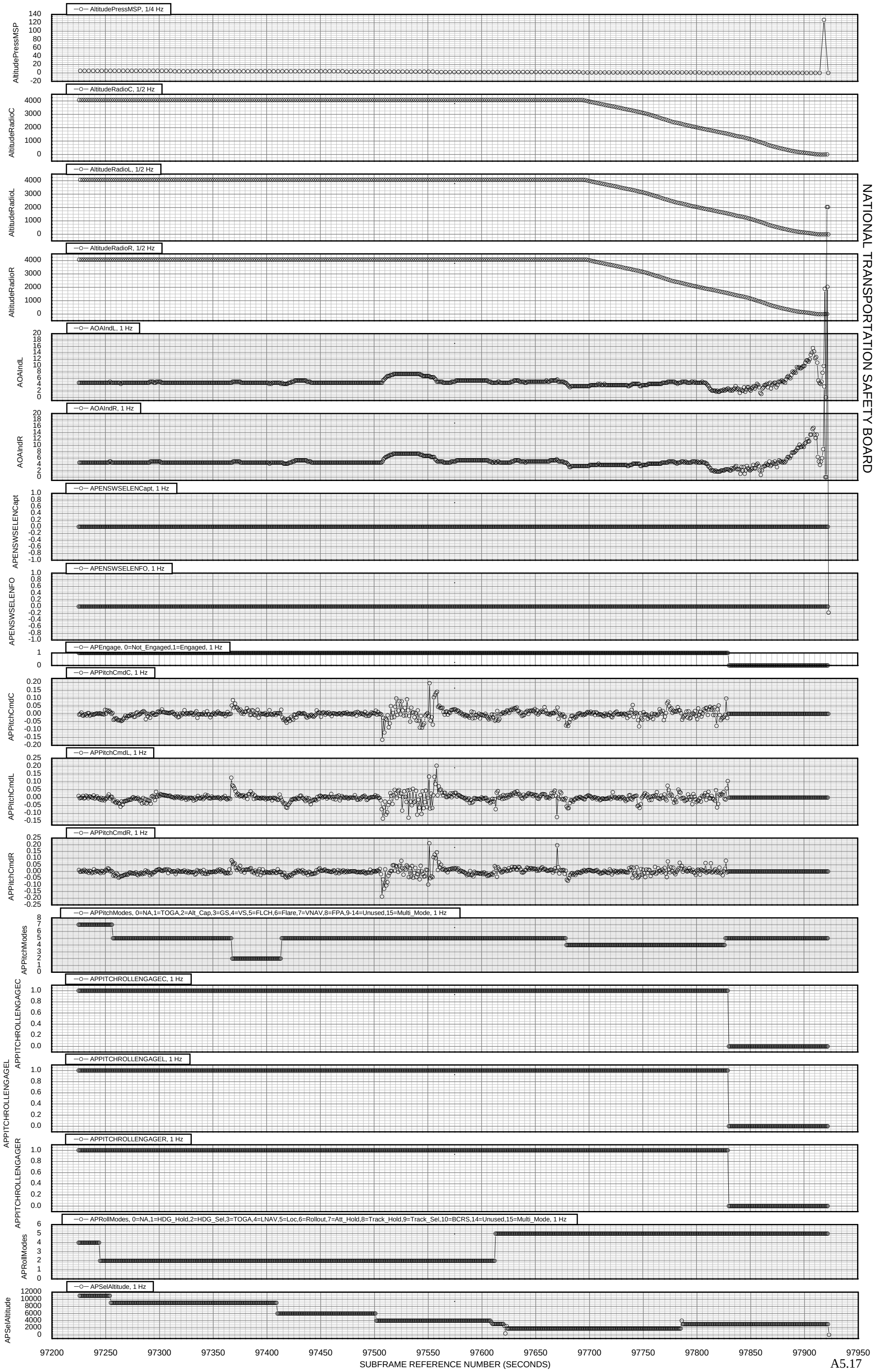

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FIGURE A5.17: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

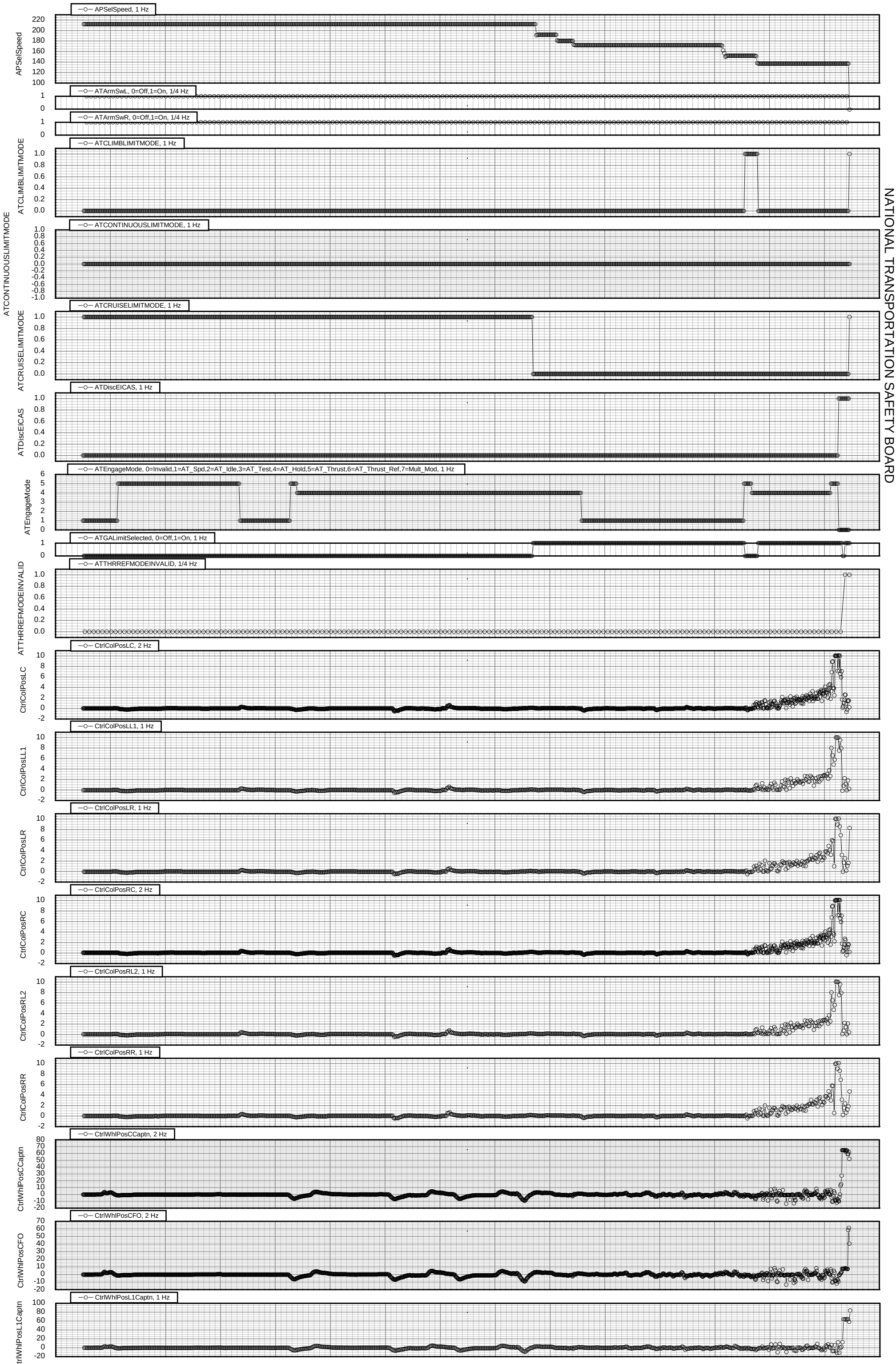

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FIGURE A5.18: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

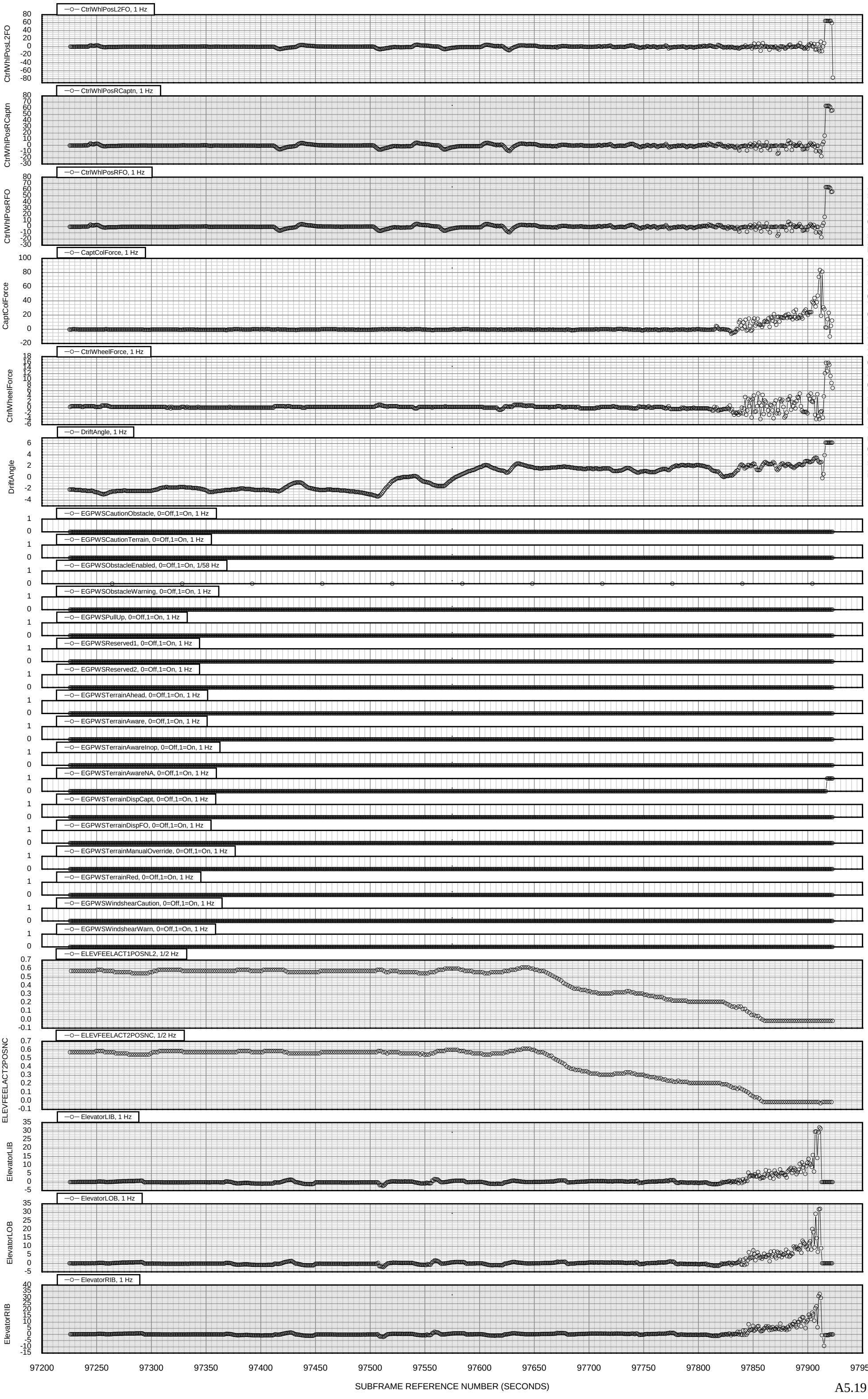

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FIGURE A5.19: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

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FIGURE A5.20: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

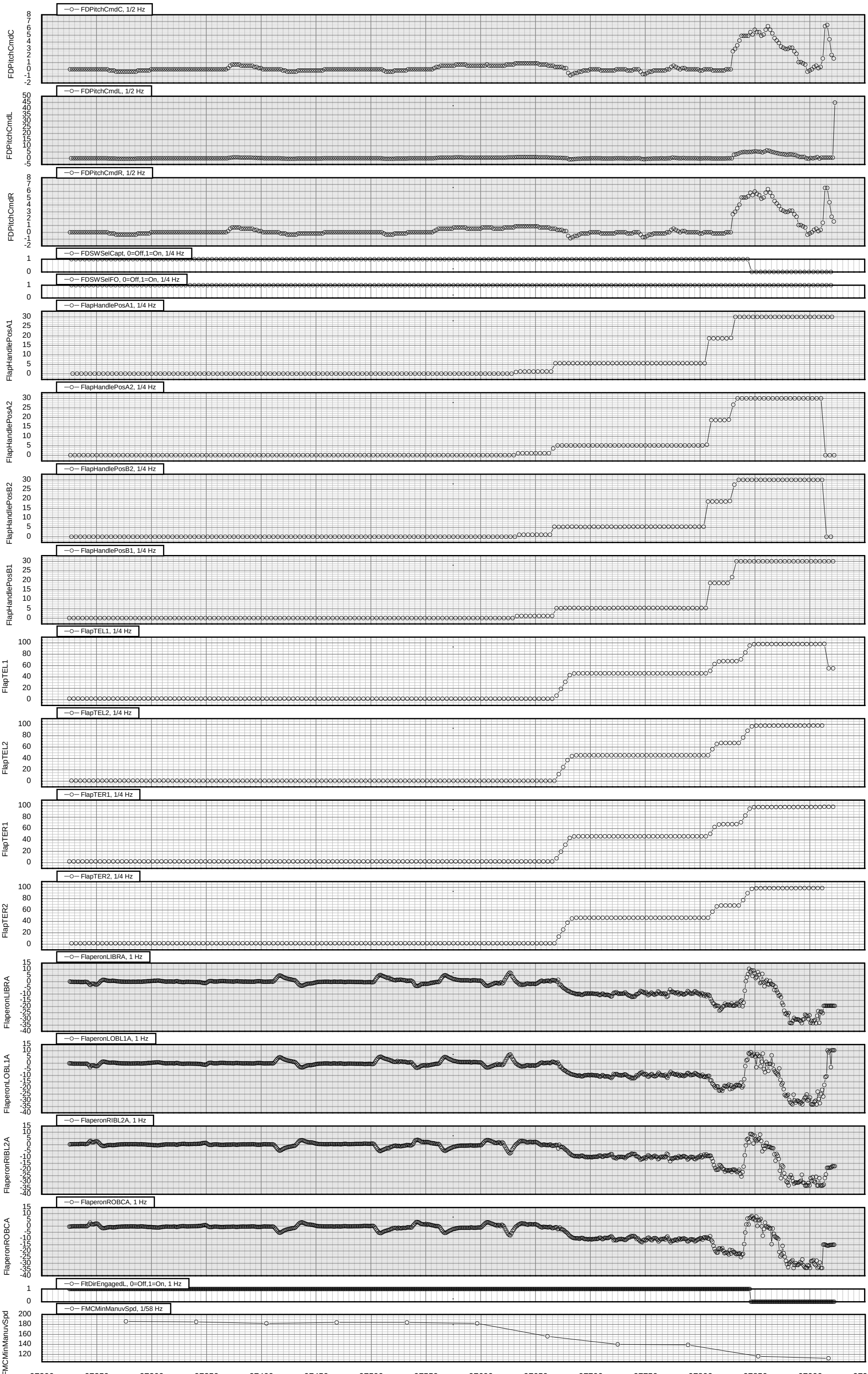

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FIGURE A5.21: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

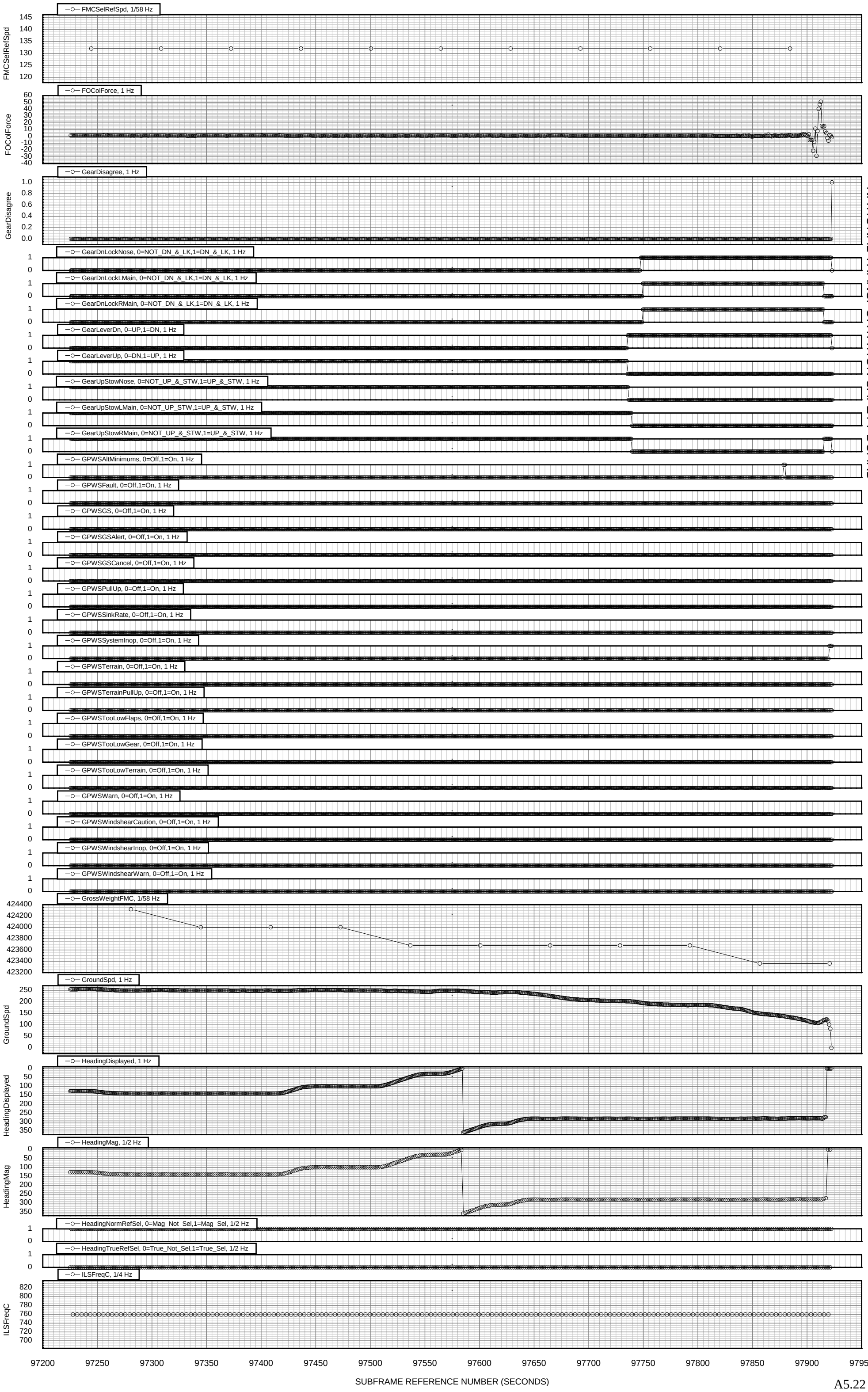

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FIGURE A5.22: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

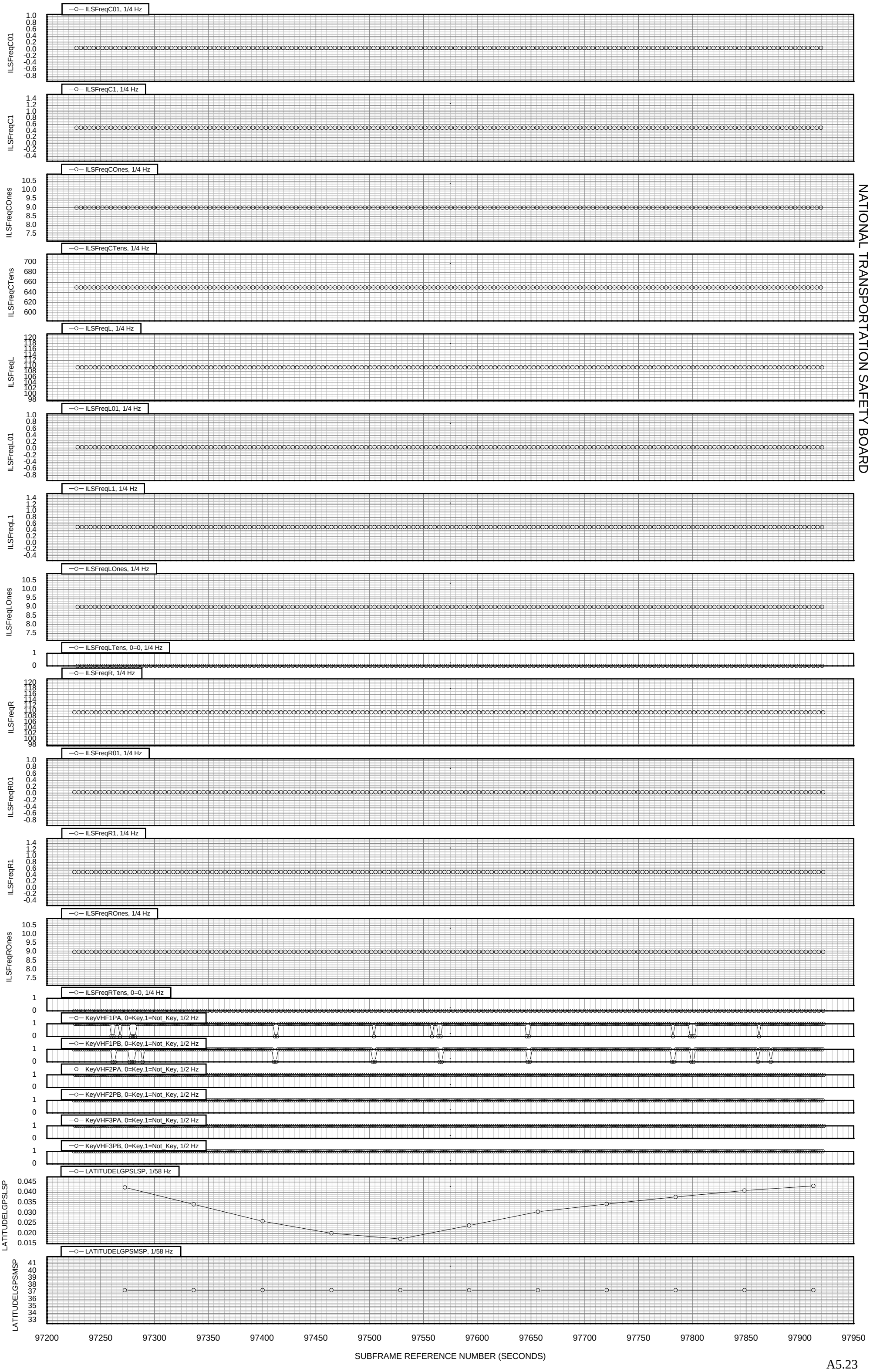

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FIGURE A5.23: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

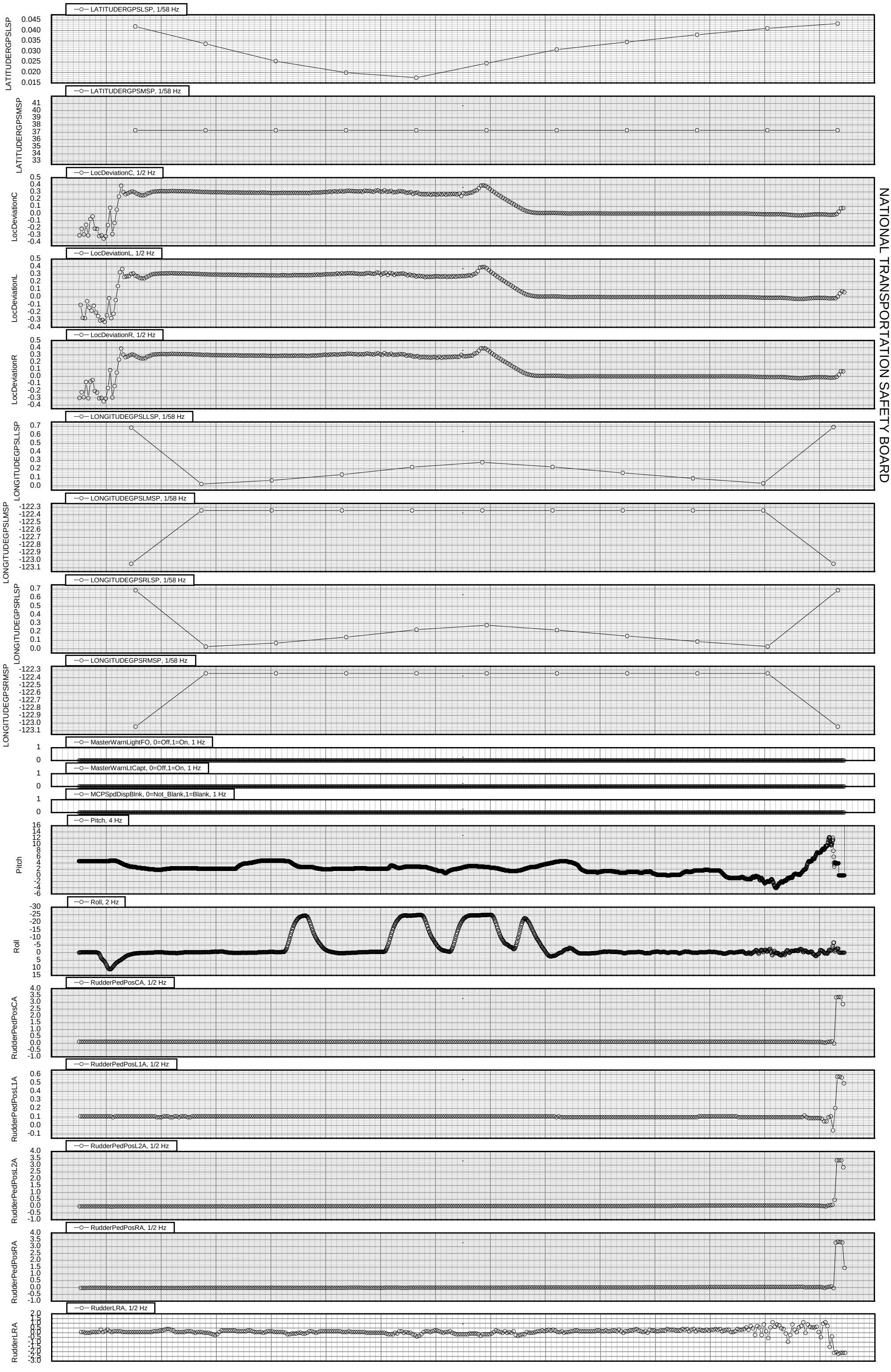

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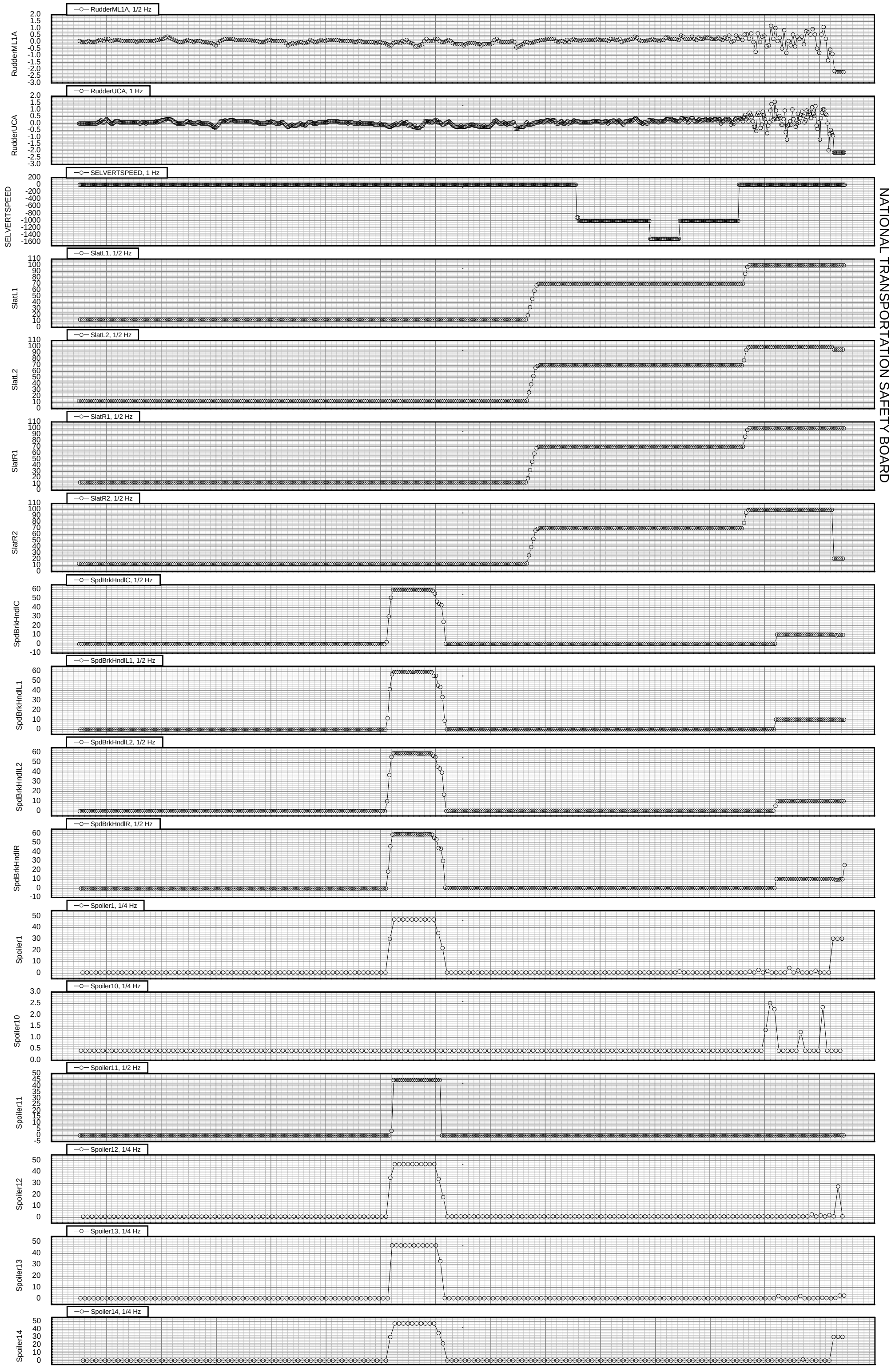
FIGURE A5.24: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]



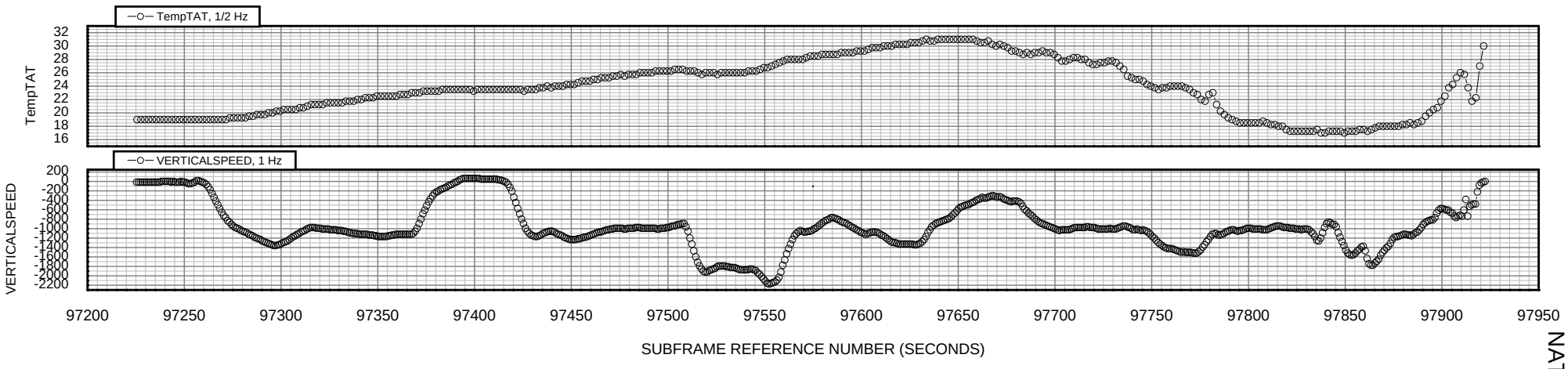
NATIONAL TRANSPORTATION SAFETY BOARD

FIGURE A5.25: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH

SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]

NATIONAL TRANSPORTATION SAFETY BOARD

FIGURE A5.26: ASIANA AIRLINES BOEING 777-200ER IMPACT WITH SEA WALL AND RUNWAY 28L ON FINAL APPROACH
SAN FRANCISCO INTERNATIONAL AIRPORT (KSFO), SAN FRANCISCO, CA; JULY 6, 2013 [FDR DATA]



Attachment 6: FAA ATC Transcripts (TRACON & Tower)

Federal Aviation Administration

Memorandum

Date: July 09, 2013

To: Aircraft Accident File SFO-ATCT-0027

From: Northern California Terminal Radar Approach Control Facility

Subject: **INFORMATION**: Partial Transcript
Aircraft Accident, AAR214
San Francisco, CA, July 06, 2013

This transcription covers the Northern California Terminal Radar Approach Control Facility (TRACON) 2B AP position for the time period from July 06, 2013, 1806 UTC, to July 06, 2013, 1823 UTC.

Agencies Making Transmissions	Abbreviations
B772, AAR214	AAR214
Northern California TRACON Boulder RADAR	2B

I certify that the following is a true transcription of the recorded conversations pertaining to the subject aircraft accident involving AAR214.

Janette Hardy
Support Specialist from Quality Control
Northern California TRACON

1806
(1807-1810)
1811

1811:05	AAR214	norcal approach good morning asiana two one four direct lozit one one thousand
1811:13	2B	asiana two one four heavy norcal approach depart san francisco v o r heading one four zero vector visual approach two eight left
1811:19	AAR214	uh after san francisco heading one four zero visual two eight left
1811:25	2B	uh two eight left affirmative

1811:27	AAR214	thank you
1812		
1813		
1813:55	2B	asiana two one four heavy reduce speed to two one zero
1813:57	AAR214	uh speed two one zero asiana two one four
1814		
1815		
1816		
1816:50	2B	asiana two one four heavy descend and maintain niner thousand contact approach one three five point six five good day
1816:57	AAR214	uh descend nine thousand one two five six five asiana two one four good day
1817		
1817:03	2B	uh just to verify one tree five point six five
1817:05	AAR214	thirty five sixty five thank you
1817:07	2B	thank you have a good day
1818		
(1819-1822)		
1823		

End of Transcript

Federal Aviation Administration

Memorandum

Date: July 09, 2013

To: Aircraft Accident File SFO-ATCT-0027

From: Northern California Terminal Radar Approach Control Facility

Subject: **INFORMATION**: Partial Transcript
Aircraft Accident, AAR214
San Francisco, CA, July 06, 2013

This transcription covers the Northern California Terminal Radar Approach Control Facility (TRACON) 2W AP position for the time period from July 06, 2013, 1812 UTC, to July 06, 2013, 1831 UTC.

Agencies Making Transmissions	Abbreviations
B772, AAR214	AAR214
Northern California TRACON Woodside RADAR	2W

I certify that the following is a true transcription of the recorded conversations pertaining to the subject aircraft accident involving AAR214.

Janette Hardy
Support Specialist from Quality Control
Northern California TRACON

1812
(1813-1816)
1817

1817:15	AAR214	approach good morning asiana two one four heading one four zero nine thousand speed of two one zero
1817:21	2W	asiana two one four heavy norcal approach caution wake turbulence you'll be following a heavy boeing triple seven
1817:27	AAR214	roger asiana two one four

1818
1819

1819:25	2W	asiana two one four heavy descend and maintain six thousand turn left heading one zero zero

1819:29	AAR214	heading one zero zero descend six thousand asiana two one four
1820		
1820:57	2W	asiana two one four heavy descend and main four thousand turn left heading zero three zero
1821:01	AAR214	heading zero three zero descend four thousand asiana two one four
1821:49	2W	asiana two one four heavy san francisco airport nine to ten o'clock one seven miles do you have it in sight
1821:56	AAR214	okay runway in sight
1821:57	2W	asiana two one four heavy turn left heading three one zero cleared visual approach runway two eight left
1822:02	AAR214	heading three one zero cleared visual two eight left asiana two one four
1823		
1823:17	2W	asiana two one four heavy reduce speed to one eight zero maintain that to a five mile final there's traffic behind and to the right that does have you in sight
1823:23	AAR214	roger speed one eight zero (unintelligible) final five miles asiana two one four
1824		
1825		
1825:36	2W	asiana two one four heavy contact san francisco tower one two zero point five
1825:39	AAR214	(unintelligible) five asiana two one four good day
1826		
(1827-1830)		
1831		

End of Transcript

Federal Aviation Administration

Memorandum

Date: July 09, 2013

To: Aircraft Accident File SFO-ATCT-0027

From: San Francisco Airport Traffic Control Tower

Subject: **INFORMATION**: Full Transcript
Aircraft Accident, AAR214
San Francisco, CA, July 06, 2013

This transcription covers the San Francisco Airport Traffic Control Tower (ATCT) LC LC position for the time period from July 06, 2013, 1815 UTC, to July 06, 2013, 1851 UTC.

Agencies Making Transmissions	Abbreviations
Local Control	LC
United 697	UAL697
Delta 1447	DAL1447
United 694	UAL694
Unknown	UNKNOWN
United 870	UAL870
United 397	UAL397
America West 466	AWE466
Skywest 5492	SKW5492
American 1486	AAL1486
Air Canada 761	ACA761
United 885	UAL885
Skywest 6263	SKW6263
All Nippon 8	ANA8
Skywest 5427	SKW5427
N73SF	N73SF
Skywest 6389	SKW6389
Asiana 214	AAR214
United 223	UAL223
Skywest 5452	SKW5452
N737JD	N737JD
Horizon 635	QXE635
SFO Airport Rescue 33	RESCUE33
SFO Airport Rescue 11	RESCUE11
SFO Airport Rescue 10	RESCUE10
SFO Airport MOBILE 101	MOBIL101
SFO Airport Rescue 37	RESCUE37
SFO Airport Mobile 244	MOBIL244
SFO Airport Rescue 88	RESCUE88
Alaska 244	ASA244

I certify that the following is a true transcription of the recorded conversations pertaining to the subject aircraft accident involving AAR214.

Andy Richards
Air Traffic Manager
San Francisco ATCT

1815
(1816-1819)
1820

1820:31	LC	united six ninety seven what's your gate
1820:33	UAL697	ninety three
1820:35	LC	united six ninety seven roll down to quebec hold short runway two eight left
1820:38	UAL697	hold uh short of two eight left on quebec united six ninety seven
1820:42	LC	delta fourteen forty seven no delay traffic's approaching a two mile final one right wind one eight zero at seven cleared for take off
1820:47	DAL1447	one right one right cleared for take off delta fourteen forty seven
1820:51	UAL694	san francisco tower united six ninety four two miles outside of tango two eight right
1820:56	LC	united six ninety four san francisco tower runway two eight right cleared to land
1820:59	UAL694	two eight right cleared to land two eight right united six ninety four

1821

1821:02	LC	united three ninety seven cross runway two eight left contact ground point eight
1821:07	UAL697	(unintelligible) cross two eight left and over to ground united (unintelligible)
1821:09	LC	united eight seventy heavy turn left at uh quebec

		contact ground on point eight
1821:14	UNKNOWN	blocked
1821:16	LC	united eight seventy heavy turn left at quebec contact ground point eight
1821:19	UAL870	quebec ground point eight united eight seventy heavy
1821:22	LC	united six ninety seven give way to your company there exiting at quebec cross runway two eight left and contact ground on point eight
1821:29	UAL697	cross two eight left and over to ground united six ninety seven thanks
1821:32	LC	united three ninety seven at taxiway delta cross runway two eight left contact ground on point eight
1821:36	UAL397	cleared to cross uh two eight left delta ground point eight and we were stepped on three ninety seven
1821:41	LC	okay no problem
1821:42	UNKNOWN	it's my fault
1821:44	LC	cactus four sixty six san francisco tower runway one right line up and wait traffic's landing westbound
1821:48	AWE466	line up and wait one right cactus four sixty six
1821:51	DAL1447	delta fourteen forty seven contact norcal departure see ya
1821:54	DAL1447	going to departure see ya later delta fourteen forty seven
1822:00	SKW5492	skywest fifty four ninety two two eight left
1822:02	LC	skywest fifty four ninety two san francisco tower runway two eight left cleared to land caution wake turbulence

		seven five seven off your right hand side for the parallel
1822:08	SKW5492	cleared to land two eight left skywest fifty four ninety two
1822:21	LC	cactus four sixty six take it uh on the roll runway one right cleared for take off
1822:26	AWE466	all right we'll keep it rolling and cleared for takeoff one right cactus four sixty six
1822:30	LC	american fouteen eighty six san francisco tower runway one right line up and wait traffic will land westbound
1822:34	AAL1486	one right line up and wait american fourteen eighty six
1822:38	LC	air canada seven sixty one keep it rolling across runway two eight left contact ground on one two one point eight traffic three mile final
1822:44	ACA761	(unintelligible) to cross twenty eight left for air canada seven sixty one
1823		
1823:09	LC	united eight eight five heavy san francisco tower cross runway one left runway one right hold short of two eight left traffic in position on one right
1823:17	UAL885	uh cross one left one right tuh two eight left united eight eight five
1823:22	LC	cactus four sixty six contact norcal departure good day
1823:25	AWE466	cactus four sixty six so long
1823:43	LC	air canada seven six one contact ground on point eight
1823:59	SKW6263	tower skywest sixty two sixty three uh inside the bridge two eight right
1824		
1824:03	LC	skywest sixty two sixty three san francisco tower runway two eight right cleared to land caution wake turbulence

		seven five seven just landed your runway and heavy triple seven off your left hand side for the parallel
1824:14	SKW6263	all right cleared to land two eight right skywest sixty two sixty three
1824:21	ANA8	san francisco tower all nippon eight heavy on final two eight left
1824:27	LC	american fourteen eighty six no delay traffic's on a two and a half mile final wind one nine zero at seven runway one right cleared for take off
1824:34	AAL1486	cleared for take off one right american fourteen eighty six
1824:36	LC	all nippon eight heavy san francisco tower runway two eight left cleared to land
1824:39	ANA8	two eight left cleared to land all nippon eight heavy
1824:42	LC	skywest fifty four ninety two contact ground point eight
1824:45	SKW5492	point eight skywest fifty four ninety two
1824:47	LC	united six ninety four hold short runway two eight left
1824:50	UAL694	hold short two eight left united six ninety four
1824:52	LC	skywest fifty four twenty seven san francisco tower runway one right line up and wait
1824:57	SKW5427	line up and wait on one right skywest fifty four twenty seven
1825:00	N73SF	tower helicopter seven three sierra foxtrot gap departure
1825:06	LC	helicopter seven three sierra foxtrot uh san francisco tower gap departure approved squawk zero three six three

1825:14	N73SF	and tower you're breaking up three sierra foxtrot
1825:17	LC	copter three sierra foxtrot gap departure approved do not overfly the heavy seven four seven under tow
1825:25	SKW6389	hey tower skywest sixty three eighty nine coming up on the bridge for the right
1825:28	LC	skywest sixty three eighty nine san francisco tower runway two eight right cleared to land caution wake turbulence heavy triple seven ahead to your left for the parallel
1825:37	LC	american fourteen eighty six contact norcal departure
1825:40	AAL1486	american fourteen eighty six
1825:44	LC	skywest sixty three eighty nine san francisco tower runway two eight right cleared to land caution wake turbulence heavy triple seven over the bridge for the parallel
1825:52	SKW6389	cleared to land two eight right the traffic's in sight skywest sixty three eighty nine
1825:56	AAR214	good morning asiana two one four final seven miles south two eight left
1826		
1826:02	LC	skywest fifty four twenty seven hold in position taxi up to the power point on departure fly heading of uh zero one zero
1826:12	N73SF	tower helicopter seven three sierra foxtrot gap departure
1826:15	LC	helicopter seven three sierra foxtrot san francisco tower gap departure approved squawk zero three six three
1826:22	N73SF	zero three six three gap three sierrra foxtrot
1826:24	LC	skywest fifty four twenty seven on departure fly heading zero one zero runway one right cleared for take off without delay

1826:30	SKW5427	take off without delay skywest fifty four twenty seven
1826:32	LC	united two twenty three san francisco tower runway one right line up and wait and we might be able to get you out this hole
1826:38	UAL223	line up and wait runway one right united two twenty three
1826:41	LC	all nippon eight heavy contact ground point eight
1826:43	ANA8	point eight all nippon eight heavy
1826:46	LC	skywest sixty two sixty three hold short runway two eight left
1826:50	SKW6263	short two eight left skywest sixty two sixty three
1826:52	LC	united two twenty three just hold in position you'll be in the next hole
1826:55	UAL223	sounds good united two twenty three hold in position uh one right
1826:59 1827	AAR214	tower asiana two one four short final
1827:08	LC	asiana two one four heavy san francisco tower runway two eight left cleared to land
1827:10	AAR214	cleared to land two eight left asiana two one four
1827:13	LC	skywest fifty four twenty seven fly runway heading and contact norcal departure
1827:17	SKW5427	going to departure skywest fifty four twenty seven good day
1827:21	UAL885	tower united eight eight five
1827:23	LC	united eight five uh tower

1827:26	UAL885	united eight eight five at the end uh we might need a few more minutes just a heads up
1827:30	LC	united eight eight five roger hold uh short of two eight left let me know when you're ready
1827:34	UAL885	two eight left united eight eighty five
1827:36	SKW5452	san francisco tower skywest fifty four fifty two uh quiet bridge visual two eight right
1827:40	LC	skywest fifty four fifty two san francisco tower runway two eight right cleared to land
1827:45	SKW5452	cleared to land two eight right skywest fifty four fifty two
1827:54	LC	copter three sierra foxtrot radar contact passing six hundred
1827:58	N73SF	six hundred three sierra foxtrot
1828		
1828:08	LC	skywest sixty three eighty nine go around
1828:10	SKW6389	go around skywest sixty three eighty nine
1828:11	UNKNOWN	(unintelligible) one thousand five hundred feet over san carlos
1828:14	LC	skywest sixty three eighty nine fly heading two eight zero maintain three thousand
1828:18	SKW6389	zero three thousand skywest sixty three eighty nine
1828:26	AAR214	uh tower tower asiana two one four
1828:29	LC	asiana two fourteen heavy emergency vehicles are responding
1828:33	AAR214	asiana two one four

1828:35	LC	emergency vehicles are responding
1828:38	AAR214	uh uh (unintelligible) uh asiana (unintelligible)
1828:45	LC	cessna seven three seven juliet delta san francisco tower remain clear of the san francisco bravo airspace contact san carlos tower
1828:51	N737JD	seven juliet delta contacting san carlos tower and uh will remain clear
1828:57	LC	cessna helicopter three sierra foxtrot leaving the bravo airspace in two miles radar service terminated squawk maintain v f r frequency change approved
1829		
1829:03	UNKNOWN	please show all runways closed for the time being please
1829:06	LC	all runways are closed the airport is closed san francisco tower
1829:10	UNKNOWN	roger that
1829:11	LC	horizon six thirty five san francisco tower
1829:15	AAR214	tower two one four
1829:16	LC	asiana two fourteen heavy san francisco tower
1829:18	AAR214	(unintelligible)
1829:23	QXE635	horizon six thirty five's going around
1829:24	LC	horizon six thirty five fly heading two six five maintain three thousand one hundred
1829:28	QXE635	two six five three thousand one hundred horizon six thirty five
1829:32	AAR214	(unintelligible)

1829:33	LC	asiana two fourteen heavy emergency vehicles are responding they have everyone on their way
1829:37	AAR214	(unintelligible)
1829:39	LC	skywest fifty four fifty two san francisco tower go around
1829:42	SKW5452	going around skywest fifty four fifty two
1829:46	LC	skywest fifty four fifty two fly heading two eight zero maintain three thousand
1829:49	SKW5452	two eight zero at three thousand skywest fifty four fifty two
1829:56	LC	horizon six thirty five fly heading two six five maintain three thousand one hundred
1830:00	QXE635	yes sir two six five three thousand one hundred horizon six three five
1830:03	LC	horizon six thirty five contact norcal departure on one three five point one
1830:07	QXE635	thirty five one horizon six thirty five
1830:09	LC	skywest fifty four fifty two contact norcal departure on one three five point one
1830:13	SKW5452	thiry five one skywest fifty four fifty two
1830:20	SKW6389	skywest sixty three eighty nine we'll go to san jose
1830:24	LC	skywest sixty three eighty nine roger and uh contact norcal departure
1830:27	SKW6389	departure uh frequency for that please
1830:29	LC	one three five point one skywest sixty three eighty nine

1830:30	SKW6389	good day
1830:42	RESCUE33	san francisco tower rescue three three on mike to cross one left one right
1830:47	LC	rescue three three san francisco tower proceed to the scene cross all active runways
1830:50	RESCUE11	san francisco tower rescue eleven is crossing with rescue three three one left one right
1830:57	LC	rescue eleven san francisco tower proceed as requested cross all runways
1831		
1831:33	RESCUE33	san francisco tower rescue three three and rescue eleven clear of the ones
1831:37	LC	rescue three rescue eleven roger
1831:41	LC	the rescue vehicle at taxiway foxtrot san francisco tower
1831:46	RESCUE10	san francisco tower this is rescue ten at foxtrot to cross one left one right
1831:49	LC	rescue ten san francisco tower cross runway one left cross runway one right
1831:53	RESCUE10	rescue ten crossing one left crossing one right
1832		
1833		
1833:39	UAL885	tower united eight eight five
1833:40	LC	say again
1833:43	UAL885	tower this is united eight eight five we are holding short of two eight left uh we see people and i think that we should uh (unintelligible) immediate attention they are alive and walking around
1833:53	LC	united eight eight five heavy roger

1833:58	LC	i think you said you said uh people are just walking outside the airplane right now
1834		
1834:01	UAL885	yeah uh some uh some people (unintelligible) look like they're struggling
1834:05	LC	roger we have emergency vehicles responding
1834:07	UAL885	uh thank you
1834:16	UAL885	right out near the two eight right number on the uh right side of the runway
1834:23	LC	roger you are reporting a person at the uh two eight right numbers
1834:27	UAL885	excuse me the two eight left numbers between the runways there are people right right uh adjacent to the numbers i we can see about two or three people that are moving and uh and uh apparently survived
1834:36	LC	roger
1834:50	MOBIL101	and tower mobile one oh one on foxtrot to cross one left one right
1834:53	LC	mobile one zero one san francisco tower cross runway one left cross runway one right
1834:57	MOBIL101	cross one left runway one right mobile one oh one and company
1835		
1835:22	MOBIL101	tower mobile one oh one and company clear of the ones
1835:28	LC	mobile one zero one and company roger
1836		
1836:29	LC	down so all right status is current everything is shut down no transitions no traffic uh lighting is on radar alignment's with oakland west end is uh ours which we're not doing anything with right now (unintelligible) asiana two fourteen heavy's on two eight left he's got everything deployed over there we got multiple rescue vehicles everybody's coming out we already rang i don't

		have any of their call signs but they're all out over there i just i gave them a blanket thing to go to the crash scene blanket thing to go to the crash scene alright yup loaded on one right short of two eight left short of two eight left i haven't done anything with anyone okay
1837		
1837:07	RESCUE37	san francisco tower this is uh rescue thrity seven permission to cross nineteen right nineteen left on charlie
1837:18	LC	rescue thirty company crossing ones alright okay got it
1837:20	RESCUE37	uh it's carbon uh crossing the ones
1837:24	LC	you got everything got it you good okay alright
1838		
1838:02	RESCUE37	tower this is uh rescue thirty seven permission to cross at papa permission to cross two eight right two eight left
1838:11	LC	rescue thirty seven approved
1838:14	RESCUE37	rescue thirty seven crossing two eights
1838:18	LC	rescue thirty seven cross the two eights proceed to the incident
1838:24	MOBIL244	tower mobile two four four uh and the spots to cross uh two eight right
1838:29	LC	mobile two four four and company cross two eight right
1838:31	MOBIL244	two eight right at papa two four four and company
1839		
(1840-1841)		
1842		
1842:36	RESCUE88	uh san francisco tower this is rescue eighty eight confirm that i'm uh i'm clear to cross runways
1842:42	LC	rescue eighty eight field is yours
1842:44	RESCUE88	uh copy that eighty eight

1843
1844

1844:39	UAL223	and tower united two two three
1844:46	LC	united two two three
1844:47	UAL223	permission to shut down the engines here
1844:49	LC	yeah i recommend everybody out there shut down the engines we'll give all about a ten minute heads up if we're gonna be able to get departures out off the ones but we're trying uh focusing on the issue right now uh sorry about that if united six ninety four and sixty two sixty three skywest we're uh trying to work on approval to get you guys across but we need that from the city right now

1845

1845:07	SKW6263	skywest sixty two skywest sixty two sixty three uh we understand we'll hold short and uh we'll wait as long as it takes
1845:15	LC	yeah that's fine i wouldn't uh shut yours down though because if i can get you across and out of the way i am definitely going to we're but working that out with the city right now
1845:22	SKW6263	we'll keep (unintelligible) monitoring
1845:24	LC	okay for united two uh correction six ninety four we'll let you know
1845:27	UAL694	roger
1845:29	ASA244	uh tower for alaska two forty four number three at one right we'd like to go back to the gate when we can work it out
1845:35	LC	alaska two forty four roger that um we'll work that out uh in the meantime i would suggest you shut them down or at least shut one down to save some out there um because it's going to be a while before i can get anybody back to the gates
1845:46	ASA244	not a problem we'll shut em down thanks

1845:48 LC thanks
1846
(1847-1850)
1851

End of Transcript

Attachment 7: Elevator System Description

Flare Compensation

The flare compensation function operates when the airplane descends through 50 feet of radio altitude. The flare compensation function supplies a pitch-down command that simulates the natural attitude of the airplane in ground effect.

Stall Protection Function

The stall protection function uses the angle of attack from the ADIRU. It also uses the computed airspeed (CAS) and the mach number. The FSEU supplies the position of the flaps and slats and the WEU supplies stall data.

The stall protection function operates only in the air.

If the airplane approaches a stall condition, the stall protection function sends a signal to the elevator for pitch-down command. The function also increases the column feel force in the column aft direction.

Elevator Rig Position Function

The elevator rig position function is active only in the air when the flaps are at the 25 or 30-unit positions. The function monitors the position of the horizontal stabilizer to move the neutral position of the elevator to a maximum of 4 degrees trailing-edge-up. This elevator position increases the down lift of the horizontal stabilizer during landing.

The elevator neutral position moves from 0 to 4 degrees trailing edge up in proportion to the stabilizer movement from 2 degrees leading-edge-up to 2 degrees leading-edge-down. When the stabilizer is from 2 to 11 degrees leading-edge-down, the elevator neutral position stays at 4 degrees trailing-edge-up.

The control column does not move as a result of the elevator rig position function.

Elevator Feel Logic

The elevator feel logic monitors the CAS. The logic sends a signal to the ACE for the elevator feel actuators. As the airspeed increases and decreases, the feel logic commands the actuators to extend and retract respectively.

When one of the two elevator feel actuators is defective, the elevator feel logic sends a much larger command to the good actuator to compensate for the defective one.

If the airplane approaches a stall condition, the stall protection sends a signal to the elevator feel logic to increase the elevator feel force if the pilot pulls the column. The signal does not change the feel force if the pilot pushes the column.

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - NORMAL MODE

Elevator Offload Function

The elevator offload function operates only in the air.

It uses the elevator commands to determine when the elevator is not at the neutral position for more than two seconds minimum. The function then commands the horizontal stabilizer to move as a function of airspeed. The movement of the horizontal stabilizer then causes the elevator to move to the neutral position.

The function is inhibited during these times:

- During flare
- During stabilizer commands
- During alternate trim lever use
- When roll or pitch attitude is more than 30 degrees.

See the horizontal stabilizer control section for more information (SECTION 27-41).

Attachment 8: Aileron and Flaperon System Description

Aileron and Flaperon Schedules

The flaperon schedule has fixed limits that let the surface move through its full authority range.

Aileron and Flaperon Droop

When the flaps extend, the PFCs use flap position data from the FSEUs to calculate aileron and flaperon droop. The PFCs add these droop commands with the signals from the aileron and flaperon schedules.

Landing Attitude Modification

The landing attitude modification (LAM) logic decreases the flaperon droop when the airplane is in an overspeed approach with flaps at the 25-unit or 30-unit position. The PFC calculates the reduction of flaperon droop proportionally to the overspeed increment. Full flaperon droop removal occurs when the airspeed is 20 knots more than the approach landing speed shown in the airplane flight manual.

When the LAM logic is active, it reduces wing lift and causes an increase in angle-of-attack. This increases the nose gear ground clearance.

Attachment 9: Related Asiana Airlines Guidance & Procedures

7.7 Descent

7.7.1 Preparation

For descent prep, use ACARS, ATIS, VOLMET or other means to receive information for the destination airport.

7.7.1.1 FMS (FMGS) Set

a. For descent (approach), input data into FMS (FMGS) using Route Guide and chart.

b. Input the alternate airport data in case of diversion.

7.7.1.2 Flight Instrument and Landing Data

a. Insert or select the frequency, course and other data for descent and approach.

b. If necessary, check the accuracy of navigation aids required for instrument approach.

c. DH and/or MDA Set

Minimum altitude(DH or MDA) for each type of approach will be based on the airplane POM.

7.7.1.3 Company report

Refer to FOM chapter 13, communications.

7.7.1.4 Approach Briefing

a. In principle, approach briefing should be performed before TOD.

b. PF shall perform the briefing while checking FMS (FMGS) data and approach chart.

c. Approach Briefing Items

Approach Briefing items are as follows,

1) Weather and NOTAM
2) Approach Chart Review
3) Crew Action and Callout
4) Non-Normal (Ab-Normal) Configuration & Conditions
5) Landing & Taxi in Procedures
6) Other Information
7) Special Briefing

d. Special Briefing

Perform special briefing in the following event.

1) If needed for destination airport.
2) If special approach and landing procedure exists.
3) If PIC decides it is necessary for weather (tail wind, cross wind, low vis etc) or airplane condition.
4) Temporarily unstable approach condition or non normal (ab-normal) procedure is needed.

7.7.1.5 PA for Descent

Refer to FOM chapter 2 Operational Policy “Passenger Announcement” and company “PA guide book”

7.7.1.6 QFE Operation for Arrival

a. Use extreme caution when setting altimeter in QFE operating airports.

b. Refer to FOM chapter 6, weather, “Altimetry” for QNE-QFE conversion guide.

c. For QFE takeoffs, refer to POM of your airplane type.

7.7.1.7 Operating Procedures for rate of climb

In order to prevent unnecessary ACAS(TCAS) resolution except ATC instruction, the rate of climb should be below 1500fpm when approaching 1000ft before level off once the pilot is aware of another airplane already flying in the assigned altitude.

7.7.2 Descent Procedures

7.7.2.1 General

a. If there is a special descent procedure at the destination airport, that procedure takes priority.

b. Use OFP or ECON speed for descent speed.

c. Calculate TOD and maintain descent profile for effectiveness and fuel economy.

d. Try to maintain clean configuration as long as possible for fuel economy.

e. Maintain appropriate descent profile using track distance, raw data and DME on FMC.

7.7.2.2 Descent Airspeed

Refer to POM for appropriate airplane type.

7.7.2.3 En-route Descent

Refer to POM for appropriate airplane type.

7.7.2.4 TL (Transition Level)

a. Select appropriate QNH or QFE for the destination airport.
   For approach at the QFE airport, refer to POM for appropriate airplane type.
b. At transition level, set the barometric pressure of the airport and the flight crew cross check the altitude.

7.7.2.5 Passing 10,000 FT

a. At or below 10,000 FT, maintain 250kts or specific descent speed designated by the airport.
b. Follow sterile cockpit procedures as a “Important Flight Phase”
c. Refer to FOM chapter 2, Operational Policy.

The end of section

7.8 Approach

7.8.1 NAVAID Set Up

a. Keep checking A/C position relation to the NAVAID.

b. Set approach frequency/course according to POM and recheck during descent checklist and approach briefing.

Note) All the NAVAIDs should be used after identified. And check the distance of the NAVAID from runway threshold.

WARNING

If the NAVAID is located off-airport, NAVAIDS location from the end of runway should be included in the approach briefing.

7.8.2 Approach Airspeed Control

a. When special procedure exists for approach speed at the airport, follow that procedure.

b. If proper speed is selected at the right time using auto throttle, the movement of thrust lever can be minimized.

c. Since additional configuration may increase drag, if possible, delay flaps extending.

Note) PM should checks speed before flaps settings.

1. PF : "Flaps One"

2. PM : "Speed Check Flaps One"

7.8.3 Initiation an Instrument approach

a. Final approach fix or beginning of final approach sector if final approach fix dose not exists, in order to continue the approach below must satisfied.
   1) Weather information by the approved airport authority.
   2) Latest weather for the airport is above approach minimums.

b. If weather is below minimum, pilot will not make the approach passed final approach fix. Unless weather report falls below minimum after passing the final approach fix.

Note) Final approach sector starts at the final approach fix or ground facility noted on the instrument approach chart. If procedure turn is included in the approach and final approach fix is not depicted, the final approach sector starts at a point where airplane is on final approach course, on runway heading and after when procedure turn is complete.

c. If approach ban procedure exists for the airport, follow that procedure.

7.8.4 Scan Policy

Apply scan policy to obtain visual reference and to check flight instruments during final approach until landing for a safe landing. For details, refer to POM for appropriate airplane type.

7.8.5 Stabilized Approach

a. Apply Stabilized Approach Procedures for a safe approach and landing and to prevent CFIT (Controlled Flight Into Terrain). For details, refer to POM for appropriate airplane type.

b. The approach shall be stabilized by 1,000 feet (HAT) in IMC, 500 feet (HAT) in VMC. If the approach is not stabilized at that altitude, a go-around should be made.

Note) VMC at 1,000ft AFE means the pilot has visual contact with runway visual reference.

7.8.6 Standard Callout and Response Procedure

For details, refer to POM for appropriate airplane type.

7.8.7 Approach Charts

During an approach and landing, flight crew (PF/PM/additional crew) will arrange and organize airway charts (STAR, Approach Chart, Airport Diagram Chart etc) for easy access.

7.8.8 Barometric Setting

a. Both PF and PM will set appropriate altimeter at the same altitude.

b. For CAT-I and non-precision approach, RA shall not be used because terrain effect.

Note) Use of RA in CAT-II/III Approach where RA is not authorized, a detailed briefing will be made during approach briefing.

c. For barometric and RA setting, refer to POM for appropriate airplane type.

7.8.9 Maximum Descent Rate

a. Maximum Descent Rate to prevent CFIT is as follows

1) 5,000 FT ~ 2,000 FT AGL : 3,300 FPM

2) 2,000 FT ~1000 FT AGL : 1,500 FPM

3) Below 1000 FT: Stabilized Approach criteria

b. Penetration of Maximum Descent Rate is possible in below conditions,

1) When Monitoring altitude is not be performed for a while by non-normal conditions.

2) When it is not enough time to recognize that A/C approaches ground dangerously.

3) When PF/PM's Cross Check is not enough.

7.8.10 Cold Temperature

Refer to FOM chapter 6, Weather and POM for appropriate airplane type.

7.8.11 Automatic flight director system (AFDS)

Refer to POM for appropriate airplane type.

7.8.12 Noise Abatement (Approach)

a. To reduce noise level during approach, continuous descent and reduced power/drag technique is recommended.

b. For airport noise abatement procedure, refer to Route Guide.

7.8.13 Landing Configuration

a. Flight crew should change configuration according to the airport speed restriction or special procedures(ex : Delayed Flaps Approach, Landing Gear Down Operation, etc)

b. Other detail configuration items are based on the airplane POM.

7.8.14 Landing Checklist

Landing Checklist time could be variable according to the approach types and airplane, but in principle, it should be completed before 1000 FT (HAT).

The end of section

2.9 Restriction

2.9.1 VFR Operation

a. Flight Crew may accept Visual Approach or Charted Visual Flight Procedure (CVFP) under ATC's authorization if the situation falls into one or more of the following conditions.
   1) Aircraft is below controlled space, terminal traffic area or altitude of transition area.
   2) Aircraft is under control by ATC.
   3) VFR condition according to Flight Safety Regulations Chapter 8 (VFR weather minima for T/O & L/D)
   4) Aircraft is in weather condition which is at same or better than VFR weather minima
   5) Aircraft is within 35NM from destination airport and proceeding traffic is visible, flight crew can keep airport insight during approach and landing or ground navigational facilities is visible whole time during CVFP.

b. Flight crew may cancel IFR plan and proceed with VFR if weather condition fulfills VFR condition described in Flight Safety Regulations Chapter 8 and one of the following condition is met.

c. Aircraft is operating in TCA (Terminal Control Area) or TRSA (Terminal Radar Service Area)related to destination airport, within controlled space or terminal traffic area, under radar surveillance by ATC and flight crew established direct communication with ATC.

d. Flight crew established direct communication with air-ground facility which provide airport traffic information and one of the following additional condition is fulfilled.
   - Aircraft is operating within 10NM from destination airport
   - Flight crew can keep visual cues on landing surface during approach and landing.

Shipper's Declaration for Dangerous Goods

It means a form that the shipper reports the nature of dangerous goods, how to pack, etc. to airline. The shipper shall make out it by himself and hand in 2 copies to airline.

Situation Awareness

It is recognizing current affairs and foreseeing necessary things in the future. This is a core part of decision making and to be accomplished by utilizing proper management behavior of other crewmembers.

Snow Grains

It is precipitation of very small white and opaque particles of ice that are fairly flat or elongated with diameter of less than 1mm (0.4inches).

Special Aerodromes

It is an airport which is designated by Director of CASA according to Flight Safety Regulation8.4.8.33 (Designated special aerodromes) and where the pilot shall exercise special caution for take off and landing.

Stabilized Approach Procedure

It is the concept that an aircraft with landing configuration is keeping stabilized speed, rate of descent and vertical / horizontal flight path. Attempt for landing should not be made unless stabilized approach is possible. Refer to chapter 7 Normal Operations Procedure "Stabilized Approach requirements"

Standard Operational Weight (SOW)

It is also called Operating Empty Weight (OEW) or Dry Operational Weight (DOW). It is the weight including the operational items required for an airplane to fly. It may vary depending on the flight type or routes even for the same aircraft. It is the weight on which the Weight & Balance work, basic of the load control service is based.

7.8.3 Initiation an Instrument approach

a. Final approach fix or beginning of final approach sector if final approach fix dose not exists, in order to continue the approach below must satisfied.
   1) Weather information by the approved airport authority.
   2) Latest weather for the airport is above approach minimums.

b. If weather is below minimum, pilot will not make the approach passed final approach fix. Unless weather report falls below minimum after passing the final approach fix.

Note) Final approach sector starts at the final approach fix or ground facility noted on the instrument approach chart. If procedure turn is included in the approach and final approach fix is not depicted, the final approach sector starts at a point where airplane is on final approach course, on runway heading and after when procedure turn is complete.

c. If approach ban procedure exists for the airport, follow that procedure.

7.8.4 Scan Policy

Apply scan policy to obtain visual reference and to check flight instruments during final approach until landing for a safe landing. For details, refer to POM for appropriate airplane type.

7.8.5 Stabilized Approach

a. Apply Stabilized Approach Procedures for a safe approach and landing and to prevent CFIT (Controlled Flight Into Terrain). For details, refer to POM for appropriate airplane type.

b. The approach shall be stabilized by 1,000 feet (HAT) in IMC, 500 feet (HAT) in VMC. If the approach is not stabilized at that altitude, a go-around should be made.

Note) VMC at 1,000ft AFE means the pilot has visual contact with runway visual reference.

7.10 Landing

7.10.1 Considerations

Consider following items before landing and refer to FCOM as necessary.

a. Landing Performance Data

b. Pilot Weather Minima

c. Runway Condition

d. Landing Configuration etc.

7.10.2 Decision to Land

7.10.2.1 Responsibility

Captain has authority and responsibility to make a landing or missed approach (go-around) considering actual weather condition and stabilized approach condition.

7.10.2.2 Decision point

a. A decision point for landing is different from approach types, but it shall be made not later than MAP or authorized minimum altitude.

b. Decision point for landing.

Type of approach	Decision point
Precision Approach	DA (H) or AH
Non Precision Approach	MDA

c. Standard Callouts shall be made in according with Callout and Response Procedure when on decision point for landing to notify PM and additional crew.

12.15.2.2 Landing Risk Factors

a. A tail strike/skid on landing tends to cause more serious damage than the same event during takeoff.
b. In the worst case, the tail can strike the runway before the main landing gears, thus absorbing large amount of energy for which it is not designed.
c. Any one of following landing risk factors may cause tail strike.
   1) Un-stabilized approach
   2) Holding off in the flare or late flare
   3) Mishandling of crosswind or over rotation during go-around

12.15.3 Actions

12.15.3.1 Tail Strike

a. For actions, refer to QRH of your aircraft type.

Note) Anytime fuselage contact is suspected or known to have occurred, accomplish the appropriate checklist.

b. Land at departure airport or nearest suitable airport.

12.15.3.2 Tail Skid

a. When flight crew cannot judge whether it is a tail strike or skid, it should be considered as tail strike for flight safety and flight crew should accomplish tail strike procedure.
b. When it is judged tail skid by sound, witness statement and aircraft condition (pressurization, engine, instruments and other indications), the flight may be continued.

12.15.3.3 Inspection request of weight and balance

In case of tail strike during takeoff or landing, if it is suspected that loading is wrong, request weight and balance inspection before unloading the cargo. Talk to the dispatcher and OCC and file captain report.

The end of section

g. The PF will normally engaging the autopilot with Call out, and the PM also shall engage the auto pilot by the order PF.

Note) PF must put hands on control wheel and thrust lever in preparation of conducting manual flight after passing final approach fix in auto flight control system mode.

2.1.6.3 Time for Automation Guidelines A/P and A/T

a. When using the Autopilot and Autothrottle, pilots must adhere to the minimum autopilot engagement and disengagement altitude as stated in the FCOM VOL 1 Limitations.

b. For the purpose of improvement of manual flight skill, Instructors and Checker can control the time of auto pilot engagement, but it is usually recommended to engage auto pilot at no more than 5,000FT considering traffic in departure phase, restriction altitude and weather etc.

2.1.6.4 A/P and A/T Disengage (Disconnect) Procedure

The PF should notify to PM at Auto pilot and/or auto throttle disengagement or disconnection.

Note) PF should call out "Manual flight" at disconnecting A/P and "A/T Disconnect" at disconnecting A/T. PM must verify changing of relevant FMAs or ASA and then call out the changing..

	ASA changing	FMA changing	Alert
AP Disconnect	AP→FLT DIR	None	Aural Warning → Siren
A/T Disconnect	None	Blank	Aural Caution → Beeper

When needed, PF can disconnect A/P and/or A/T by stages. For this, first Push for disconnect then stay momently to listen aural warning or Aural Caution then second push for Reset.

2.12 Descent Procedure

2.12.1 Preparation for Descent

2.12.1.1 Generals

a. It is a general rule of descent preparation that the PM carries out upon PF's request after obtaining weather of the destination airport.
b. Recall and check all EICAS messages by pushing CANC/RCL switch.
c. Check all note items on ECL.
d. Weather Radar (User's Manual by Honeywell)
  1) During descent, control antenna tilt 1° upward per 10,000ft above 15,000ft alititude and 1° upward per 5,000ft below 15,000 ft
  2) During approach, considering terrain condition around an airport and prevent too much clutters from appering on ND maintain antenna tilt about +4° upward or tilt upward to maintain clutters appear only top portion of ND. At this time, there will be a little defference according to aircraft attitude and gross weight.

2.12.1.2 FMC Set Up

a. General

PM will program the FMC for descent and approach, comparing with Route Guide then executes the activation after confirmed by PF.

b. Approach REF Page

Enter the VREF speed based on expected landing configuration and landing weight. If this VREF is different from the VREF calculated by FMC at the time of performing approach checklist, change the VREF.

c. DEP/ARR Page

Select the expected approach, STAR, TRANSITION on arrival page.

d. LEGS Page

Connect all waypoints as required and be sure all discontinuities to be connected. Then input speed/altitude constraints required.

e. HOLD Page

Enter required data after verifying the holding procedures depicted on approach charts

f. NAV RADIO Page

1) Enter required approach data such as ILS frequency/front course, VOR frequency (or identifier) / course, OM or any other available ILS frequency/front course, on the preselect line for reference or in preparation for non-normal condition.
(Ex: 108.9/332, NCN/225)
2) In ILS frequency/front course and tune status line, auto tuning is required.

g. RTE 2 Page

Input the route from the destination airport to the alternate airport. When the active runway at the alternate airport is known, input appropriate approach procedure and runway so that make that information useful in case of diversion.

2.12.1.3 DA (DH) and/or MDA Setting

a. Set correct barometric altitude on PF and PM's altitude indicator.
b. Set both sides of altimeters on the same barometric altitude for radio altimeter.
c. RA is NOT AUTHORIZED in CAT-I and Non-ILS approach due to the terrain effectiveness.

Approach	Setting the Radio Altimeter on PFD	Setting the Barometric Altimeter on PFD
CAT-I, PAR	Blank (DH)	DA
Non-ILS Approach	Blank	MDA orMDA + 50feet Note)
		Landing Runway Circling Minimums or Company Wx Minimum (Ceiling) Whichever is higher when Circle to Land is applicable.

d. If temperature of arriving airport is below 0 ℃, apply cold temperature correction when set DA(DH) or MDA.

Note)

1. When setting minimum on PFD according to the chart using BARO minimum selector on EFIS control panel, DA(H) or MDA(H) on MCP altitude window is set at 10 ft interval

2. For VNAV coupled approach (VNAV/LNAV, VNAV/RNAV etc.) there are three category for minimum settings

a. Published VNAV DA
b. Published MDA with approved as DA
c. Using MDA+50ft without approved as DA

2.12.1.4 Autobrake Select (Recommendations)

Auto Brake	Desired Braking
MAX	When minimum stop distance is required (Deceleration rate of max auto brake is slower than full manual brake)
3 or 4	For wet or slippery runways or when landing rollout distance is limited
2 or 1	Provide a moderate deceleration effect suitable for all routine operation.

Note)

1. *It is recommended to check landing distance for landing RWY in QRH prior to set the auto brake.*
2. *Use of Autobrake 2 or stronger is recommended for economical operation as conditions permit.*

2.12.1.5 Time to do Descent Checklist

It should be performed near TOD (Top of Descent) with set up for descent and approach completed

2.12.2 QFE Operation for Arrival

Accomplish this procedure when ATC altitude assignments are referenced to QFE altimeter settings.

2.12.2.1 At Transition Level

a. Altimeter---------- Set QFE (PF/PM)

Note)

1. DO NOT use LNAV or VNAV below transition altitude/level.
VNAV altitudes in the navigation database are not referenced to QFE.

2. If the QFE altimeter setting is beyond the range of the altimeters, QNH procedures must be used with QNH set in the altimeters

b. CDU---------- Select QFE (PF/PM)

1) Select QFE on the APPROACH REF page. Set for approach
2) Use FLCH, V/S and HDGSEL mode.

2.12.2.2 Glide Slope Capture

a. QFE missed approach altitude----------Set (PF)

1) If missed approach altitude is below TA.

b. QNE missed approach altitude ----------Set (PF)

1) If missed approach altitude is above TA.

Note) Compare altitude between altitude indicator and RA on PFD.

2.12.3 Company Radio Contact

Report by ACARS and obtain gate information.
Refer to FOM, Chapter 13. Communications, “Company Radio” for voice contact.

2.12.4 PA (Passenger Address)

For detailed information on PA, refer to “Passenger Announcement” of the chapter 2. Operations Policy “Passenger Address” in FOM and company “ Captain Announcement Manual.”

2.12.5 Approach Briefing

PF makes clear and understandable briefing to PM using "Approach Briefing Items" and must hand over the control to the PM to prevent from lack of aircraft control When any situation for flight has change, or when expected, PF adds proper items to briefing.
Briefing items are as follows.

a. A time to do Approach Briefing

To keep time to do descent checklist, do approach briefing after getting destination airport information such as weather etc, then completion of approach/ landing set up in FMC-CDU and before T/D

b. Approach Briefing Items

1) WEATHER & NOTAMS (Destination / Alternate Airport)
2) ARRIVAL / APPROACH & LANDING PROCEDURES
   a) Arrival Procedures
      ① Validity of the Charts to be used
      ② Airport Elevation
      ③ TL (Transition Level), MSA (Minimum Safe Altitude)
      ④ Arrival Route, Altitude & Speed Restrictions
   b) Approach & Landing Procedures
      ① Validity of the Charts to be used
      ② Type of Approach
      ③ LOC (VOR) Frequency
      ④ Final Approach Course
      ⑤ Airport & Runway Elevation
      ⑥ IAF & Step Down Fix Altitude
      ⑦ Glide Slope Interception Altitude
      ⑧ DA(MDA)
      ⑨ Missed Approach Procedures
   c) Route to alternate airport
      ① Concerning fuel for alternate airport
   d) Apply cold temperature altitude correction as needed
3) CREW ACTIONS & CALLOUTS
4) NON-NORMAL CONFIGURATION & CONDITIONS

5) LANDING & TAXI IN PROCEDURES
   a) Check Landing Runway, Landing Weight, Landing Distance and proper Autobrakes
   b) Taxi in Procedures
6) OTHERS

2.12.6 Passing Transition Level

a. Flight crew should set and verify correct QNH or QFE of the airport.
b. PM sets altimeters using EFIS, calling out "Transition Level, Altimeter Reset (QFE: when needed) 0000" PF responds, "0000, Altitude Check" setting altimeters on PFD and standby altimeter.
c. Cross check the altitude each other.
d. Do the approach checklist.

2.12.7 Landing Preparation Signal

a. Chime 3 times by rotating seat belts selector to ON→AUTO→ON or AUTO→ON→AUTO then ON, when approach checklist is asked for.
b. Give Approach signal before reaching at least 10,000 Feet, and Seat belts selector must be at ON position.
c. If there was no special mention from the PF about when to give the approach signal in advance, the PM gives the approach signal and performs the checklist when the PF calls for APPROACH CHECKLIST.

2.12.8 Passing 10,000 ft

a. Check decent speed (example: 250 knots below 10,000 feet).
   1) All lights – ON.
   2) Any activities that would distract or interrupt performances are not allowed at critical phase of flight below 10,000 feet.
   DO not try to program FMC or fill out OFP, unless it is inevitable.

2.12.9 Considerations

2.12.9.1 Descent Speed

Input OFP descent speed in CDU DES page at approach set up and maintain that speed for descent speed (fixed descend speed). However, exceptionally when there is any controller's direction or turbulence condition is expected.

2.12.9.2 Descent Path

a. When flying in LNAV, descent in VNAV is recommended. However, under radar vectors, pilot may descend by using FLCH or V/S mode.
   An initial descent from En route to approach or flying by LNAV, using VNAV PATH for descent is recommended.
   However, when the flight route is different from the FMC input route, such as an approach under radar vectors, you may modify CDU LEG page for continue using VNAV or descend by using FLCH mode.
b. Begin descent at TOD with VNAV mode unless ATC restricts.
c. For the accurate calculation of TOD, wind data may be entered into DESCENT FORECASTS page.
d. Use speedbrakes when it is necessary for complying descent profile.

2.12.9.3 Descent Constraints

a. Descent constraints are put into FMC automatically when selecting an arrival procedure.
b. Set all mandatory altitude constraints in the MCP altitude window to prevent altitude deviation.

2.12.9.4 Speed Intervention

Use VNAV speed intervention to respond ATC speed restriction or change.

2.12.9.5 Descent Planning

a. Flight deck workload increases as the aircraft descends to the terminal area. Minimize distractions to assure flight safety.
b. Descent planning is necessary to arrive at the desired point at a proper speed and configuration.
c. The distance required for the descent is 3NM / 1000 feet altitude loss for no wind conditions using ECON speed.
d. A good reference for descent is as follow;
   1) To be at 10,000 feet AGL, 30NM from the airport, at 250 knots.
   2) When proceeding straight-in approach, plan the descent to arrive at traffic pattern altitude with flaps up maneuvering speed 12NM from the runway.
   3) When making an abeam approach, plan the descent to arrive at traffic pattern altitude with flaps up maneuvering speed 8NM from the runway.

2.12.9.6 Descent Rate

Descent Rate tables provide rates of descent below 20,000 feet with idle thrust and speedbrakes extended or retracted. Refer to "B777 FCTM"

Target Speed	Rate of Descent (Typical)	
	Clean	With Speedbrake
0.84M / 310 knots	2200 fpm	5300 fpm
250 knots	1400 fpm	3300 fpm
VREF 30 + 80	1000 fpm	2300 fpm

2.12.9.7 Use of Speedbrakes

a. The PF should keep a hand on the speedbrake lever when the speedbrakes are used in-flight.
b. While using the speedbrakes in descent, allow sufficient altitude and airspeed margin to level off smoothly.
c. Lower the speedbrakes before thrust increase.
d. To avoid buffeting, use of speedbrakes with flaps greater than 5 should be avoided.
e. When condition is required to use speedbrakes with flaps extended, high sink rates during the approach should be avoided.
Speedbrakes should be retracted before reaching 1,000 feet AGL

2.12.10 CDO(Continuous Descent Operations)

2.12.10.1 General

CDO is a method by which aircraft approach airport maintaining continuous descent from cruise altitude to IAF (Initial Approach Fix) with no Level flight segment. If CDO procedure is published for the airport, CDO should be performed unless there are restrictions. CDO is recommended if conditions permit even for the airport with no specified CDO procedures for Economical and Comfortable Operations.

Note) If the CDO procedure is not possible due to an emergency, bad weather conditions, etc, an alternate instruction will be issued by ATC or pilots can request it.

2.12.10.2 FMC set up and Briefing

a. Set up the designated STAR procedure
b. Verify and change the ALT/SPD for FMC waypoints
  1) IAF (Assigned ALT/ VREF +40)
  2) Descent speed on FMC
  3) Review the appropriate chart for CDO procedures
  4) Compare FMC data with Approach chart (Route and waypoints constraints)

2.12.10.3 Recommend procedures

a. ATC Phraseology
  1) Ex: "OZ 221 cleared JINBU 1M arrival, speed and descent at pilot's discretion, report leaving"
  2) ATC Phraseology may be changed if necessary
  3) Report to ATC when leaving current FL
b. Recommended Flight Mode
  1) Vertical : VNAV PATH(Not VNAV SPD)
  2) Lateral : LNAV
  3) Using speed on FMC - Not required speed intervention

c. MCP Altitude set
  1) Set the next mandatory altitude constraints on the MCP prior to TOD
  2) If there is no mandatory altitude constraints, set the IAF ALT (Not required to set "AT or ABOVE" constraints)
  3) Monitor the waypoints constraints during descent
d. Speed control
  1) Control speed by Speedbrakes
  2) Refer to "Drag required" FMC message
  3) Speed intervention when FMC speed is decreasing to Vref+40
    a) Prior to IAF
    b) Set VREF+40
    c) Set Flaps-5
    d) Keep the "VNAV PATH"

2.13 Approach Procedure

2.13.1 PF/ PM's Duties

2.13.1.1 PF's Duties

a. All Approach

1) A/C control and Approach Briefing
2) Follow published approach procedures.
3) Cross check all flight instruments.
4) When using AFDS, PIC should be ready for manual flight before passing FAF.

b. ILS Approaches (CAT-I), Non-ILS Approaches

1) Active visual scan is needed while approaching MDA or DA (H). But pilots should remind that main duty is to correctly operate to maintain MDA when A/C arrives MDA or DA(H).
2) If pilots have visual contact with runway reference before passing DA(H) or MAP, follow inside & outside definition and procedures.
3) PIC should decide to continue approach or make a missed approach.

c. CAT II/III

1) For CAT II/III operation, PIC's main duty is control and decision.
2) For CAT II operation, Auto approach and autoland must be conducted until touchdown. If any of the required airborne equipment for CAT-II fails, follow "Downgrade Approach" procedures.
3) For CAT III operation, Captain must make auto land and auto roll out regardless of visual key at AH/DH

2.13.1.2 PM (Pilot Monitoring)'s Duties

a. All Approaches

1) Active Standard Callout
2) Cross check all primary instrument and raw Data.
3) Monitor any display of warning/caution flags or deviation from the intended flight path and callout to PF.
4) Monitor speed and descent rate until touchdown.
5) After landing, advise runway and taxiway to PF.
6) When A/C is Un-Stabilized or safe landing is not assured, advice to PF to make a missed approach.

b. CAT I

1) Monitor flight instrument while approaching DA(H) or MDA(H) carefully.
2) Monitor airspeed and descent rate until touchdown.

c. CAT II/III

1) For CAT II/III operation, PM's main duty is to monitor AFDS.
2) Closely monitor LOC, GS (Glide Slope), Speed, etc.
3) Callout any changes in the FMA.
4) Actively follow POM standard callout procedures.

2.13.2 CRM

2.13.2.1 General

Refer to "Stabilized Approach" of this chapter "Normal Operations" in POM and "General Operations policy" of ch 2. "Operations policy" in FOM.

2.13.2.2 Deviation Callout

a. When speed, glideslope, localizer, sink rate, thrust, or visual guidance is out of approach limitation, PM should call it out clearly.
b. If immoderate landing is expected due to excess of approach limitation, opinion must be presented positively in advance.
c. If a missed approach is required, PM should advise missed approach (GO AROUND call out)
d. Deviation callouts after entering final approach segment are in accordance with "Flight Parameter Deviation Callout" of this chapter "Normal Operations" in POM.

2.13.3 Approach Category

B777 is classified as a Category "C" airplane when straight- in approach.

2.13.4 Approach Ban

a. Approach begins once an A/C has passed a final fix on the airway or radar vector has been provided by ATC.
b. Asiana Airlines's Approach Ban as follows. If there is special procedures for airport, that has priority.

2.13.4.1 Initiating Instrument Approach

a. To commence an instrument approach, the airport weather should be above the operating minimums before passing IAF (Initial Approach Fix), and A/C should have approach clearance.
b. If the airport weather becomes below landing minimum before passing IAF, PIC should decide holding or divert.

2.13.4.2 Discontinuing Instrument Approach

If the airport weather is reported below landing minimum when the A/C is between IAF and FAF, PIC can make an approach until FAF. Landing minimum when the A/C is at the FAF, PIC should discontinue to approach and perform missed approach.

2.13.4.3 Continuing Instrument Approach (When using MDA/DH)

a. Once the A/C has passed a FAF, it may continue approach to the minimum altitude (MDA/DA/DH) even if the weather becomes below minimum.
b. At the published minimum altitude (MDA/DA/DH), if the PIC has visual contact with runway or visual reference for safe landing, land on the runway and if not, perform missed approach.

Note)

1. *For CAT-III approach which applies AH, even if the weather becomes below minimum after passing FAF/FAP, PIC can continue approach and landing unless weather deteriorates to the point that A/C equipment can not permit.*
2. *Each country may have own approach ban policy. Flight crew must confirm and apply the specific procedures at the country.*

CAUTION

When the safe landing is suspected regardless A/C condition or weather, perform missed approach (Go-Around).

2.13.5 Scan Policy

2.13.5.1 Purpose

On final approach course, the following division of flight deck workload is made for instrument scan and acquisition of visual clues in order to complete a safe approach and landing.

2.13.5.2 Definition

a. Inside and Outside
Pilots will scan inside instrument and outside reference.

b. Inside
Pilots will continuously monitor the instrument.

2.13.5.3 Operation Procedure

a. During approach and landing, flight crew should strictly follow scan policy of PF/PM.

b. Scan policy is as follows.

Condition		PF	PM
Auto Coupled Approach (At or Below 1,000FT)	IMC (or at Night)	Inside & Outside	Inside
	After Visual Reference Contact	Inside & Outside	Inside
Manual approach (At or Below 1,000FT)	IMC (or at Night)	Inside	Inside & Outside
	After Visual Reference Contact	Inside & Outside	Inside & Outside
Visual approach	After Visual Reference Contact	Inside & Outside	Inside & Outside

Note)

1. *The inside & outside pilot should call "Approach Light In Sight" or "Runway In Sight" when in sight of the runway reference prior to arriving at DA(H) or MDA(H).*

2. *It is sole responsibility to final determine landing before descent below DA (H) or MDA (H).*
   When the Co-pilot (F/O) conducts a landing as a PF, (s)he will callout "Landing" or "Go Around" at minimum.
   At that time if landing is assured captainalso call out "Landing" or call "Go Around" if landing is not safe and take over aircraft contro
3. *When the Co-pilot (F/O) conducts a practice auto landing as a PF, (s)he will callout for the runway visual references before descending below DA(H) and PIC must check runway visual clues for final decision of landing.*
4. *PM should monitor airspeed and sink rate through touchdown*
5. *when there is additional pilot in the cockpit, (s)he should perform back up duty for PM during approach.*

2.13.6 Stabilized Approach

2.13.6.1 General

a. Every flight crew members must confirm and monitor a stabilized approach. In addition, the flight crew members shall plan ahead and coordinate with ATC to avoid any abrupt maneuver on an approach.
b. If a stabilized approach is not established, go-around.

Note) Deciding to make Go-Around does not mean that the procedure has been done wrong, but it means that crews follow the company safety policy and executed safety procedure normally.

2.13.6.2 Safe Threatening Factors during Unstabilized Approach

a. Un-stabilized Approach can cause an accident and lead to CFIT.
b. By having an approach without enough time for stabilized approach, safety hazards may be caused.
c. Low/Slow or High/Fast approach could cause the followings.
   1) Low/Slow (Low Energy Approach) : Can cause CFIT from not having enough obstacle clearance.
   2) High/Fast (High Energy Approach): Overrun, runway deviation or CFIT
d. Tail strike can be happened.
e. Not following altitude, speed, rate of descent etc might be the causes of accident.

2.13.6.3 Countermeasure from Un-Stabilized Approach

a. Anticipate

Make pre-discuss about Un-Stabilized Approach Factor through the briefing between PF and PM

ex) Nonstandard Altitude, Airspeed, Energy Management etc

b. Detect

Between PF and PM monitor each other and do Back-up Roll and complementary cooperation

ex) Unnecessary Actions, Improper Cockpit atmosphere etc.

c. Correct

Actively correct before develop to the more serious circumstance.

ex) Corrective Actions (Excessive Height, Excessive Airspeed, Extended the Outbound Leg or Downwind Leg) etc

d. Decide

If couldn't make or maintain Stabilized Approach, have to make Go-Around.

2.13.6.4 Stabilized Approach Recommendations

Maintaining a stable speed, descent rate, and vertical/lateral flight path in landing configuration is commonly referred to as the stabilized approach concept. Any significant deviation from planned flight path, airspeed, or descent rate should be announced. The decision to execute a go-around is no indication of poor performance

Note) Do not attempt to land from an unstable approach

2.13.6.5 Stabilized Approach Criteria

a. All approaches should be stabilized by 1,000 ft above airport elevation in IMC and 500 ft above airport elevation in VMC. An approach is considered stabilized when all of the following criteria are met:

1) the airplane is on the correct flight path
2) only small changes in heading and pitch are required to maintain the correct flight path
3) Speed: Max Target speed +10 knots, Min Target speed - 5knots (Target speed = Vref+Wind Correction)

4) the airplane is in the correct landing configuration
5) sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted
6) thrust setting is appropriate for the airplane configuration
7) all briefings and checklists have been conducted.

b. Specific types of approaches are stabilized if they also fulfill the following:
1) ILS approaches should be flown within one dot of the glide slope and 1/2 dot of localizer (at or below 1,000 ft AFE), or within the 1/2 dot of glide slope and expanded localizer deviation scale 1/3 dot (at or below 500 ft AFE).
2) during a circling approach, wings should be level on final when the airplane reaches 300 feet AFE.

c. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

Note)

1. An approach that becomes unstabilized below 1,000 feet AFE
In IMC or below 500 feet AFE in VMC requires an immediate go-around. The "VMC" above means that any of required visual references is in sight.

2. There will be delayed final flap setting during perform a certain approach such as emergency/non-normal procedure, circling approach, visual traffic pattern. In these cases checklist must be completed before final flaps.

d. At 100 feet HAT for all visual approaches, the airplane should be positioned so the flight deck is within, and tracking to remain within, the lateral confines of the runway edges extended.

e. As the airplane crosses the runway threshold it should be:
1) Stabilized on target airspeed to Max Target speed +10 knots, Min Target speed – 5knots until arresting descent rate at flare
2) On a stabilized flight path using normal maneuvering
3) Positioned to make a normal landing in the touchdown zone (the first 3,000 feet or first third of the runway, whichever is less).

Note)

1. It is acceptable to overshoot instantly in the event of turbulence, wind shear, gust wind or the sudden change of wind direction.

However, the frequent occurrence of such overshooting is not proper and should not be allowed.

2. *If PF decides to correct temporary deviations safely and recognizes present flying stage, he/she continue approaching in the event that GPWS alert " SINK RATE " was announced temporarily below 1,000FT and VMC (Visual Meteorological Conditions).*

2.13.6.6 Operation below DH or MDA

Pilot must not descend below DH or MDA to continue approaching unless following conditions are satisfactory.

a. In position where plane can land at designated runway TDZ with the normal maneuvers and normal descent rate.
b. Maintain descent rate that allows plane land at TDZ of designated runway.
c. Visibility or RVR is above the minimums of standard instrument procedure.
d. Pilot recognizes one of runway visual references.
   1) Approach Light System.
   2) Threshold Markings/Lights.
   3) Runway End Identifier Lights.
   4) Visual Glide Path Indicator (VASI, PAPI 등).
   5) TDZ or TDZ Markings/Lights.
   6) Runway or Runway Markings/Lights.

2.13.6.7 Missed Approach (Go-around) Conditions

Missed Approach (Go-Around) conditions are as follows.

a. When exceeding stabilized approach limit at 1000ft under IMC and 500ft (HAT) under VMC condition.
b. When visual contact is lost at or after MAP.
c. When Landing Configuration is not maintained.
d. When aircraft is not aligned with runway.

Note) 1. Even if the conditions of stabilized approach are not satisfied at 1,000ft or 500ft, descent may be continued with the unavoidable conditions (FAA TERPS, Local procedure, restricted maneuvering airspace etc.). However, if the approach is not stabilized below the altitude set by the specific conditions, missed approach must be accomplished.

2. During instrument approach, unless visual clues are obtained and maintained, missed approach must be accomplished under

following conditions;

a) Navigational equipments or flight instruments affect to safety approach capability are failed.

b) Localizer or glide slope indicator is fully deflecting during ILS approach.

c) A warning message means ANP exceeds RNP is displayed during RNP based approach.

d) Radio communication failure on RADAR approach.

e. Aircraft instrument, ILS component inoperative, big difference between PF/PM's instruments.

f. Windshear or abnormal weather condition

g. ATC instruction.

h. When the aircraft can not land within safe touchdown zone.

i. Non-normal or other conditions that make it impossible to land safe.

Note) Deciding to make Go-Around does not mean that the procedure has been done wrong, but it means that crews follow the company safety policy and executed safety procedure normally.

j. When exceeding wind limitation (refer to wind limitations in this POM Chapter 8 "Adverse Weather"

2.13.6.8 Standard Callout & Response

a. During ILS or Non-ILS approach, when the PM makes callout "ONE THOUSAND" at 1,000 feet (AFE), the PF should response "STABILIZED" or "go-around" in IMC or 'Checked" in VMC depend on the aircraft's situation.

b. During ILS or Non-ILS approach, when the PM makes callout "FIVE HUNDRED" at 500 feet (AFE), the PF should response "STABILIZED" or "go-around" depend on the aircraft's situation whether IMC or VMC.

c. If wings level is needed below 500feet during visual or circling approach (Refer to the FAA TERPS), the PM calls "FIVE HUNDRED" at 500 feet (AFE) and "THREE HUNDRED" at 300feet (AFE) Also, the PF should response "LANDING" or "GO-AROUND" according to the decision and immediate action should be made.

d. The PM does not make callout, when auto callout is made by system.

e. The PM should take over the aircraft control when there is no

response to the PM's callout twice from the PF at the altitude of 500 feet or 300 feet.

f. Refer to the "Standard Callout" in POM.

2.13.6.9 Flight Parameter Deviation Callout

All conditions are at or below 1000ft AFE if not specified.

Callout	Conditions
"Bank"	• Greater than 10 degrees
"Localizer"	• Greater than 1/2 dot at or below 1,000 ft AFE • Greater than 1/3 dot at or below 500 ft AFE • Greater than VOR 1/2 dot • Greater than NDB + (–) 5 degrees
"Glide Slope"	• Greater than 1 dot at or below 1,000 ft AFE • Greater than 1/2 dot at or below 500 ft AFE
"Speed"	• Speed: Exceed target speed +10/–5 kt – When Non-normal condition, apply QRH directed VREF + 5 Knots as a Target speed (Ex: Use VREF 30 + 20)
"Sink Rate"	• Greater than 1,000 FPM
"Altitude"	Target Altitude + (–) 100FT or more

Note) PM may callout as a type of "Check Speed" when airplane expecting deviate from Stabilized Approach Criteria.

2.13.7 Approach Types

Authorized instrument approach types are ILS approach and non-ILS approach.

2.13.8 Considerations before Approach

2.13.8.1 Landing Performance check

PF/PM should check following items that can affect to landing performance before approach.

a. Weather and runway condition

b. NOTAM

c. Airplane condition and defects

d. Landing weight and target speed

e. Required landing distance, etc.

Note) Landing runway for non-normal configuration must be greater than Required Landing Field Length for normal landing configuration based on runway condition (Dry or Wet) or non-normal actual landing distance, whichever is longer.

2.13.8.2 Pilot weather limitation check

a. A PIC shall not conduct an instrument approach procedure when visibility conditions are reported to be less than 3/4SM or RVR 1,200m (4,000ft) until that pilot has been specifically qualified to use normal landing minimums(CAT-I).

b. A PIC shall not begin an instrument approach procedure when the visibility conditions are reported to be less than 3/4SM or RVR 1,200m (4,000ft), unless the following conditions exist:

1) Fifteen percent additional runway length is available over the Required Runway Length specified for the destination airport by the Airplane Flight Manual.

Note) Required Runway Length is the actual landing distance multiplied by a factor of 1/0.6 (1.67)

2) All weather runway markings or runway centerline lights are operational on that runway.

2.13.8.3 Runway Condition

a. Refer to the FOM Ch. 6 for landing limitations regarding contaminated runways and braking actions.

b. When reported braking action is less than good, consider following items:

1) Limitations according to runway condition.
2) Usable Runway(s) and Taxiway(s) through the information (NOTAM, SNOWTOM, ATIS, ATC/Company advise etc)
3) Weather (specially, wind) Condition
4) Aircraft Gross Weight
5) Use of Auto Brakes
6) Other Performance Factors

2.13.8.4 Configuration

a. Make decisions about landing flap, auto brake considering landing performance, runway condition and so on.
b. Make decision about the landing method (auto landing or manual landing) considering approach types (precision or non-precision), weather conditions and the training purposes.

2.13.9 NAVAIDs Set Up for Approach

a. Keep checking aircraft's position and distance form the airport's NAVAIDs.
b. Set up VOR frequency and final approach course on MCP (auto tunning is primary and when needed manual tunning is available) when conducting cockpit setup for approach, and verify it again when performing descend checklist.
c. During VOR approach, the PF will keep MAP mode on the navigation display (ND), and the PM will display raw data on the PM'side navigation display (ND) by order of the PF until landing or missed approach.
d. It is required to check Localizer frequency/course and auto tuning status before approaching terminal area.
e. The captain will put Standby Attitude Indicator Approach switch on 'APP or BCRS (when needed)' position when reciving localizer interception or approach clearance. (Appropriate airplane)
f. On demand, marker beacon receiver in audio panel will be used, and the volume should be adjusted properly.

2.13.10 Approach Charts

Flight crew should have airway charts (STAR, Approach Chart, Airport Diagram Chart, etc) readily visible during approach and landing.

Note) 1. The assistance crew should check the Route Guide to advice, if necessary.
2. authority does not authorize EFB at this time, so approach charts in the EFB must use only as a reference (the basic date is 2009.08.01)

2.13.11 Flaps Extension Schedule

Current Flap Position	At Speed tape "Display"	Select Flaps	Command Speed for Selected Flaps
UP*	"UP"	1	"1"
1	"1"	5	"5"
5	"5"	20	"20"
20	"20"	25 or 30	(VREF25 or VREF30) + wind additives

2.13.11.1 Flaps 5

a. It is required to pass IAF at flaps 5 maneuvering speed with flaps 5 (With the exception of special cases).
b. To prevent aircraft from overshooting the locaizer course, flaps 5 and flap 5 speed should be achieved no later than intercepting final approach course the Localizer
c. During staring-in approach, flaps 5 and flaps 5 maneuvering speed should be achieved no later than approximately 12nm to prevent excessive using of thrust.
d. During visual approach, flaps 5 and flaps 5 speed should be achieved no later than entering downwind.

2.13.11.2 Landing Flaps (Flaps 25/30)

a. The following table represents time to extend specified flaps and landing gear. (Exception of circling and visual approach)
b. It is required to adjust the time for configuration change in order to meet the requirements or procedures in local airport (Speed limit, delayed flaps approach, landing gear down operation. etc) or direction from ATC.

L/G Down & Flaps 20	Landing Flaps
• Glide Slope Alive or • 2,400FT (AFE) or • 8 DME or • 2 NM prior to FAF • apply special procedures of specific airport.	• 1,800FT (AFE) or Glide Slope Capture or • 6DME or • prior to FAF • apply special procedures of specific airport.

2.13.12 Speed Control

Proper speed control can minimize the movement of thrust levers.

2.13.13 Conducting Landing Checklist

a. Once landing configuration done, the PF will check landing gear position indication, Flaps position, and SET APPROACH SPEED and MISSED APPROACH ALTITUDE on MCP, and then order the PM to read landing checklist.

b. PM opens landing checklist immediately after setting landing flaps then conducts the checklist by order of PF and call out “Landing checklist complete clear to land (or continue approach) RWY OO L/R”. In addition, when approach to the airport with two or more runways in use (including paralleled runway), verify the runway to land in order to prevent any confusion.

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2.15 Non – ILS Instrument Approach

Non-ILS instrument are defined as LOC (LOC BC), VOR, NDB, LDA (LDA/DME) and SDF.
VNAV is the preferred method of flying non-ILS approaches. V/S or FPA may be used as an alternate method (Supplementary Procedures) for accomplishing non-ILS approaches if VNAV method cannot be used (due to aircraft performance or when VNAV is not authorized).

2.15.1 General

2.15.1.1 Recommended Pitch and Roll Mode

Classification	Pitch Mode	Roll Mode
LOC	VNAV, V/S, FPA	LOC, LNAV
VOR, NDB	VNAV, V/S, FPA	LNAV, HDG SEL TRK SEL

2.15.1.2 The Use of LNAV

To use LNAV for approaches, a proper series of legs/waypoints that describe the approach route must be appeared on the LEGS page. There are two methods of loading these waypoints.

a. Data base (FMC) selection

1) Select an approach procedure through the FMC ARRIVALS page.
2) If the approach to be flown is not in the database, another approach having the same plan view may be selected. For example, an ILS procedure might be selected if the plan view(route) is identical to an NDB approach, when an NDB approach to be flown is not in the database.
In this case, waypoint altitudes must be checked and modified as required.
3) When an approach is flown by this ‘overlay’ method, raw data should be monitored throughout the approach to assure obstacle clearance.
4) If a waypoint is added to or deleted from a database procedure, FMC “on approach" logic is partially or completely disabled and VNAV obstacle clearance integrity of the procedure may be adversely affected. If an additional waypoint reference is desired, use the FIX page and do not modify waypoints on the LEGS page.

b. Manual Waypoint Entry

1) When no procedure is available from the FMC ARRIVALS page, manual entry of a series of waypoints may be accomplished.
2) Then waypoints may be conveniently defined by using names of waypoints or navies in the database, bearing/distance from such fixes, intersections of radials or latitude/longitude information. (Procedure turns and DME arcs cannot usually be manually entered.)
3) Deviation from the defined route may require use of 'DIRECT TO' or 'INTERCEPT LEG TO/ INTERCEPT COURSE TO'. (when intercept the inbound course)
4) Constant monitoring of raw data during the approach is required.
5) HDG SEL or TRK SEL should be used to fly the approach ground track.

Note) Automatic procedure turning and VNAV PTH operation using speed intervention are not available with manual entered waypoints.

c. ND Mode Select (Raw Data Monitoring Requirements)

1) The PF should select MAP mode for ND mode, ND range should reach to 10NM before FAF/FAP.
2) Monitor raw data when performing the localizer-based approach (LOC, LOC-BC, LDA, SDF & IGS)
3) Raw data monitoring is recommended during performing non-localizer base approach (VOR, TACAN, NDB, RNAV GPS, etc)
4) Raw data monitoring is not required for the airplanes equipped FMC which has two operational FMCs, two IRSs and two GPS receivers (or two DME receivers if GPS updating is not available)or RNP/ANP. However, raw data monitoring can be performed by the PF's decision.
5) When raw data monitoring is required, the PF ask change approach mode for ND mode to the PM before final course Intercept. (callout: "L/H or R/H side raw data")
6) The PM change ND mode from MAP mode to proper mode (approach or VOR mode) by the PF's demand, and keep it until landing or missed approach (Go-Around).

Note) It must be needed monitoring raw data when operating non WGS-84 application air space (ex: Russia, Mongol, China).

2.15.1.3 The use of V/S or FPA

When V/S or FPA is used for approaches CDFA (Continuous Descent Final Approach) is preferred method. (No level flight segment at minimums)

a. Preparations

1) Recommended Roll Mode

Approach Methods	Recommended Roll Mode
RNAV, GPS, LOC-BC, VOR, NDB	LNAV, TRK SEL, HDG SEL
LOC, SDF, LDA	LOC, LNAV

2) Approach Set up

a) Select the approach procedure from the ARRIVAL page of the FMC

b) Tune and identify appropriate navaids.

c) If additional waypoint references are desired, use the fix page.

d) If required verify/modify the appropriate RNP.

e) MDA SET

① Airports with authorized DA : use DA (regions under EU-OPS)

② Airports with authorized MDA : use MDA

If CDFA(Continuous Descent Final Approach) is made to MDA(H), set MDA+50ft to avoid descending below MDA(H) during the missed approach.

f) VDP (Visual Descent Point)

① Try to arrive at VDP at MDA wherever VDP is established.

② Most VDPs are between 1 and 2 NM from the runway. The following table provides more examples.

HAA(FT)	300	400	450	500	600	700
VDP Dist', NM	1.0	1.3	1.5	1.7	2.0	2.3

Reference

Descent gradient

3) IF the final speed is 140knots

- 300FT/NM = 700FPM, 400FT/NM = 933FPM

4) IF the final speed is 150knots

a) 300FT/NM = 750FPM, 400FT/NM = 1,000FPM

b) 3°Glide path = 318FT/NM
c) 2.8° Glide path = 300FT/NM
d) 3.8° Glide path = 400FT/NM

b. Approach Procedure

1) Approaching FAF
a) Use appropriate Pitch mode and Roll mode until FAF.
b) Approaching FAF (approximately 2NM), select gear down and flaps 20 and adjust speed.
c) Set the MCP altitude window to the first intermediate altitude or MDA.

2) At or after FAF
a) At or after the FAF, select V/S or FPA mode and at appropriate vertical speed to arrive at the MDA at VDP to allow a normal landing profile.
b) Vertical speeds vary with the ground speed on final approach.
c) If no recommended vertical speeds are available on the published approach chart, set approximately −700 to −800 fpm, which is result of 1/2 Ground speed×10 FPM when glide path is 3°.
d) When FPA mode is used, if no descent angle or glide path angle is available from the approach chart, set −3° initially.
e) When stabilized in adescent, make an adjustment to a descent rate to achieve a constant angle. There should be no level flight segment at minimum.

3) Approaching MDA
a) Be preparing to land or go around from the MDA at the VDP. Note that a normal landing cannot be completed from the published MAP on many instrument approaches.
b) Approximately 300 feet above the MDA, select the missed approach altitude.

4) At MDA
a) Before leaving the MDA, disengage autopilot and land.
b) Turn both F/Ds off, and then place the PM's F/D on. This eliminates allows continued F/D guidance for PM in the event of a go around when pitch or roll mode is changed.
c) Do not continue approach below MDA unless appropriate visual reference is established.

2.15.1.4 Use of VNAV

a. General

Using VNAV is primary procedures at NON- ILS approaches (preferred method)

1) Instrument approaches using VNAV is a performance based approach procedures and it calculate GP angle from FAF to 50 feet above specific runway threshold and follow that. And at this time it only be authorized for previously mentioned segment.
2) VNAV is working with LNAV, HDG/TRK SEL or LOC mode for an approach.
3) Select the appropriate approach profile in FMC ARR page.
4) Do not construct waypoint data manually or make additional waypoint to the approach procedure.

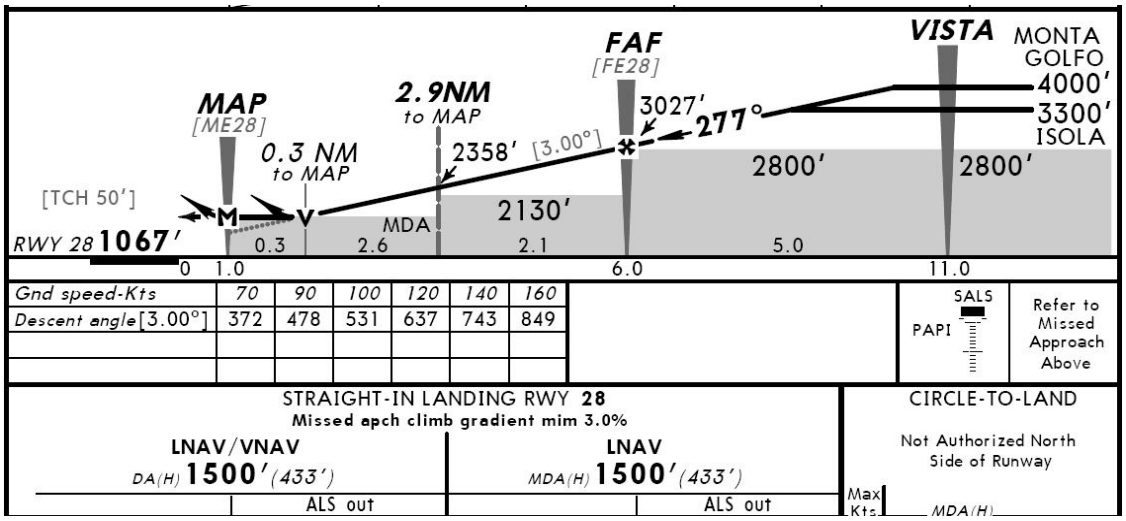
Note) With the waypoint programmed manually in FMC, VNAV PATH operation working with procedure turn and speed intervention function is not available.

5) When OAT is below 0°C, cold temperature altitude correction should be applied to the restriction altitude (altitude constraint) for a waypoint in accordance with the authorized altitude correction chart. Cold temperature altitude correction should be applied to all waypoints including missed approach below published MSA and after correcting the altitude, crosscheck should be done between PF and PM to prevent mistakes.

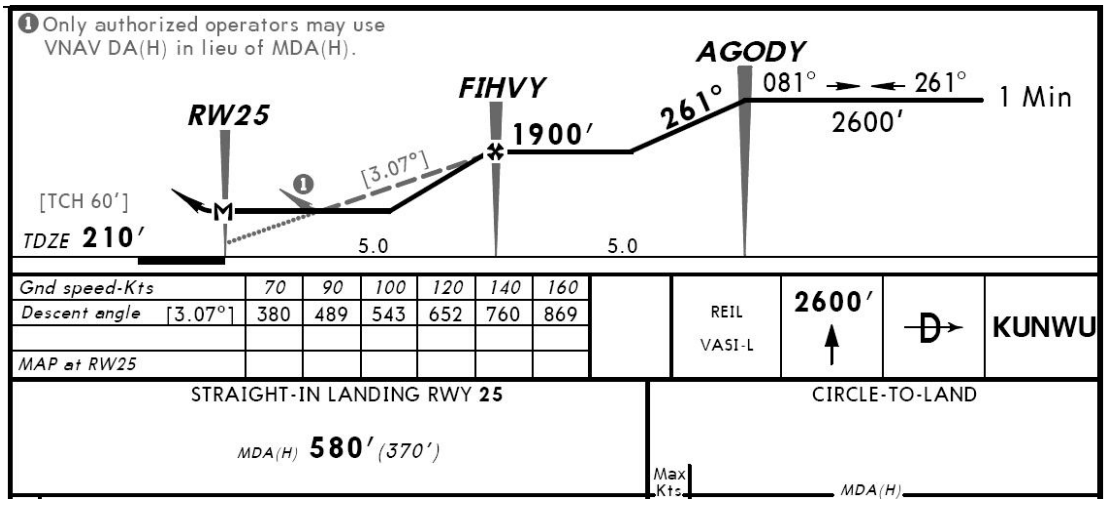
b. Approach Chart (Profile View)

1) Chart with VNAV information (VNAV Path, VNAV Angle)

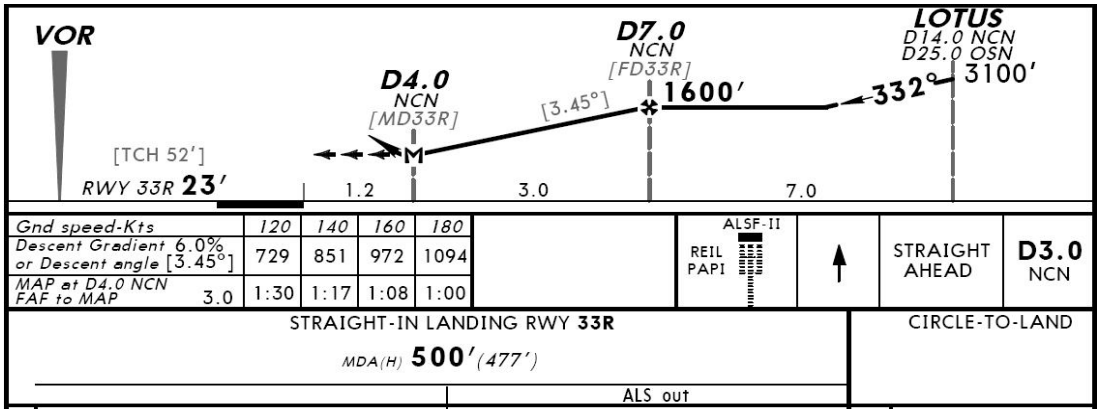
a) When DA/DH is authorized in the profile view;



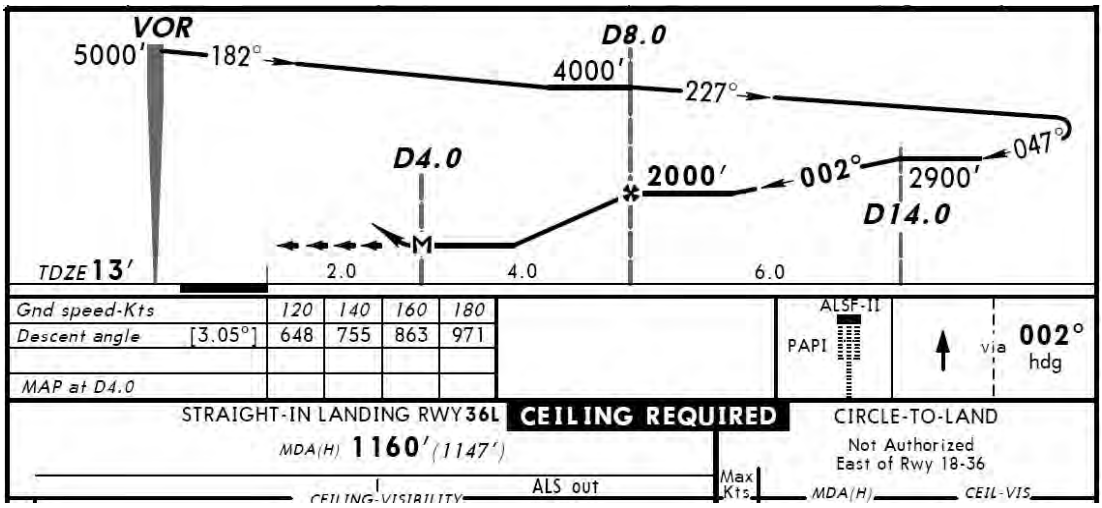
b) When MDA (H) is authorized to be used as DA (H) in the profile view ;



c) When MDA (H) is authorized in the profile view ;



2) Chart without VNAV information;
VNAV approach can be executed If vertical path angle is displayed on the FMC-CDU LEG page.



c. Restrictions

1) VNAV Approach can not be performed under following cases (on the Approach Chart);
   a) In case of the MAP is beyond the runway threshold and VNAV angle is not appeared in CDU LEGS page.
   b) In case of no glide path angle is displayed on the final approach segment of the LEGS page on the FMC.
   c) In case ofthe vertical path of RNAV approach is not designed to cross the runway threshold at approximately 50 feet.
2) For other considerations, VNAV Approach can not be performed under following cases ;
   a) In case of the actual navigation accuracy exceeds its required value.
   b) If the airport temperature is below the minimum published temperature for the procedure being flown.
   c) In case of "LNAV ONLY" is written on the RNAV (GPS) approach chart.
   d) In case of QFE operation is in progress.

d. Preparation for VNAV Approach

1) FMC Approach Procedure Set Up

   a) Select the approach procedure from the ARRIVAL page of the FMC.
   b) Do not add or delete waypoints manually. If you do so, automatic procedure turning and VNAV PTH operation using speed intervention are not possible.

c) After set up compare following items between approach and FMC data.
① Approach VNAV path
② Approach VNAV angle
③ Distance from FAF to runway or MAP.
④ Confirm waypoints on final approach coruse and its altitude.

2) RNP

After IAF check RNP as required

Approach Type	RNP
NDB, NDB/DME	0.6 NM
VOR, VOR/DME	0.5 NM
RNAV(VOR/DME)	0.5 NM
RNAV(GPS)	0.3 NM

3) DA or MDA

Classification	When DA authorized	When authorized the use of DA in lieu of MDA	When MDA authorized
Chart with a published VNAV	Apply DA	Apply MDA as a DA	Set MDA + 50ft applying MDA
Chart without a published VNAV	VNAV Approach is available; however, MDA is applied and MDA (H) +50 is set for minimum.		

e. Considerations

1) Speed Intervention
a) When the FMC is “on approach”, the following features are available:
① The IAS/MACH window can be opened and the command speed can be set while VNAV remains in VNAV PTH descent; VNAV commands the set speed
② The MCP altitude can be set above the airplane altitude for the missed approach. When the MCP altitude setting is at least 300 feet above the current airplane altitude, VNAV continues to command a descent
b) Adding speed constraints to the final approach waypoints is not recommended because of the extra workload, no safety benefit, and reduced ability to make last minute approach changes.

2) Altitude Constraints

a) Confirm the altitude constraints of waypoints on the final course (Compare approach chart with FMC).

3) Autopilot

In general, pilots fly the airplane with the autopilot engaged until establishing visual reference. (To reduce pilot's workload)

f. Approach Procedures

1) Before 2NM to FAF

a) Before FAF, airplane should be on the descent phase and to join final approach course may follow controller's vectoring direction or fly via IAF to FAF along a STAR .

There are some kind of descent method such as VNAV, FLCH SPD, V/S and FPA, so pilot can choose an appropiate method fit that situation.

When descend make continuous descent rate as possible, for not violate altitude constraint of a FIX or directed altitude by ATC controller, pilot must understand about each descent method's characteristics throughly and careful attention must be paid.

b) If IAS/MACH Window was closed, open the window and control speed by IAS/MACH Selector on the MCP

c) Adding speed constraints to the final approach waypoints is not recommended because of the extra workload

d) When Radar vectorig by controller, request long final interception if needed.

e) When vectored to FAF or FAF extension course, NAV RDO frequency/ course and/or value of RNP does not change automatically until a FIX included in specific approach, therefore manually set FREQ/ Course and RNP value in to the PM side CDU and check in advance.

Note)

An approach via IAF

1. Basically, for descent, reset next lower constraint, but where there are closely spaced waypoints between the IAF and the FAF, PF

may set FAF altitude initially. However, each pilot gives careful attention whether the altitude constraints are kept.

2. Where there is published GP angle between the IAF and the FAF, PF may set DA(H) when intercepting the published GP.

2) Approximately 2NM to FAF

a) Set DA(H) or MDA(H) on MCP (with ALT or VNAV ALT FMA displayed or during VNAV PATH approach)

b) Push VNAV switch on the MCP (during VNAV PATH approach omit this procedure)

c) Confirm FMA status on PFD (VNAV Path/APP NAV)
When Radar vectorig by controller, request long final interception if needed.

d) Airport where raw data (CDI-Course Deviation Indicator) can not be confirmed during VNAV approach, check RNP (Required Navigation Performance) and ANP (Actual Navigation Performance) if it complies with the requirments.

e) PM Check the VNAV Path pointer and Deviation scale and callout "Approaching Glide Path or FAF." Then PF direct "Gear down, Flaps 20" (optional landing flaps 1 engine)

f) Confirm raw data if necessary (eg : Radial, DME, ALT, CDI etc)

3) FAF

a) Confirm FAF passing altitude

b) Descend to DA(H) or MDA(H)

c) Landing flaps (2 engine, optional 1 engine)

d) Do the Landing checklist

e) Monitor VNAV path

f) Confirm descent status (beginning of descent, descent angle, descent rate etc)

4) After FAF

a) Confirm raw data if necessary (eg : Radial, DME, ALT, CDI etc)

b) Set missed approach altitude on the MCP after passing at least 300 ft below missed approach altitude.

c) Convert to manual flight when visual reference is established

while approaching DA (H)/MDA (H)

d) Make missed approach at DA (H)/MDA (H) if visual reference is not established.

e) Preform missed approach 50ft above MDA(H) when MDA (H) is applied

5) MCP Altitude Window Setting

a) When setting minimum on PFD according to the chart using BARO minimum selector on EFIS control panel, DA(H) or MDA(H) on MCP altitude window is set at 10 ft interval.

6) Descent

Descend can be started when ;

Classification	Descent can be started
VOR Approach	When VOR CDI is within 1 dot. (Within half full scale deflection for VOR)
DME ARC Turn	When maximum tolerance is within ± 2NM.
NDB Approach	Within ± 5° of the required bearing for NDB.

7) At 1,000FT (AFE)

a) PM calls out “1,000 (One Thousand)” at 1,000FT (AFE).

b) PF Responses as “Checked” (VMC) “STABILIZED” or “GO-AROUND” (IMC).

c) If MDA (H) is at or above 1,000FT AFE, PM does not call out “1,000” or “500,” but “APPROACH MINIMUM” and “MINIMUM”.

d) If there is no response from PF after making “1,000” or 500” callout twice, PM should take over the control with saying “I HAVE CONTROL”.

8) At 500FT (AFE)

a) PM calls out “500 (Five Hundred)” at 500FT (AFE).

b) PF Responses as “STABILIZED” or “GO-AROUND”. When an aircraft is stabilized, PF respondes “STABILIZED” and continues approach for normal landing.

c) When an aircraft is unstabilized, PF executes missed approach immediately.

d) If there is no response from PF after making “1,000” or 500” callout twice, PM should take over the control with saying “I HAVE CONTROL”.

9) 100FT Above MDA(H) (Except Visual Approach)
a) PM calls out "Approaching Minimums" at 100FT above MDA (H).
b) PF Responses as "CHECKED" and continues approach for normal landing or responses as "GO-AROUND", and executes missed approach immediately when aircraft is unstable.

10) At MDA (H) (Except Circling/Visual Approach)
a) PF
① When PM calls out "MINIMUM" before passing MDA(H), PF responses "LANDING" if landing is considered "possible" in accordance with the conditions described in consideration STABILIZED APPROACH and turns F/D OFF, disengages autopilot, and continue to land.
② If PM calls out "MINIMUM" and no visual cue confirmed, PF responses "GO-AROUND" and execute a GO-AROUND.
③ If the landing runway is confirmed but the aircraft is not at the position where the safe landing can be made, executes a MISSED APPROACH.

Note). It is sole responsibility to final determine landing before descent below DA (H) or MDA (H). When the Co-pilot (F/O) conducts a landing as a PF, (s)he will callout "Landing" or "Go Around" at minimum.. At that time if landing is assured captainalso call out "Landing" or call "Go Around" if landing is not safe and take over aircraft controls.

b) PM
① PM calls out "MINIMUM" at MDA (H).
② If there is no response from PF after making "MINIMUM" callout, PM should take over the control for landing or missed approach verbalizing "I HAVE CONTROL, LANDING (or GO AROUND)".
③ If PF responses "LANDING" at MDA (H), turn the F/D OFF then ON and switch the ND to MAP mode.

Note) When approach using VNAV, FD indicate normal flight path angle to the 50 ft above runway threshold, so pilot may use this information if needed.

11) Missed Approach Altitude Setting

If one of the following requirements is met, missed approach altitude can be set.

a) If VNAV is used as pitch mode, set MCP altitude to the missed approach altitude when airplane is at least 300FT below the missed approach altitude and stabilized on final approach in VNAV PTH, or,

b) When the aircraft passes FAF, PF tries manual landing calling out "(RUNWAY IN SIGHT, LANDING"), set MCP altitude to the missed approach altitude.

g. Contingency Procedure

1) LNAV-VNAV Approach with RNAV (GPS)
If VNAV becomes inoperative during an approach, it is required to select other vertical mode to enable LNAV only approach, which using MDA.

2) RNAV (VOR/DME) or Other Approach Procedures
If VNAV mode fails or something is wrong with the FMC NAV DATA, select other vertical mode to keep flying all the way down to the MDA (H).

2.15.2 Localizer Approach

a. Localizer Approach does not provide glide slope, and pilots should prepare for the change to Localizer Approach when making an ILS Approach.

b. Select LOC switch after confirming the followings.
1) The localizer is turned and identified,
2) The airplane is on an inbound intercept heading,
3) The localizer pointer appears on PFD in proper position,
4) Approach clearance issued.

c. Confirm the final approach condition to localizer course, monitoring LOC pointer on PFD.

d. Notify ATC immediately when aircraft crosses localizer course without a prior instruction from ATC.

e. Descent can be made using VNAV, V/S, FPA or FLCH; However, VNAV shall not be used when additional waypoint is made which is

not included on the profile.

f. PM shall confirm each step down fix altitude and make standard callout.

2.15.3 Back course LOC Approach

a. Back course (BCRs) Localizer Approach is a Non-ILS approach procedures use back course information of a localizer and glide slope information is not available.

b. B777 has Back course (BCRs) Localizer Approach Reverse sensing capability, so during approach for controlling azimuth use LOC deviation pointer as front course adjustment.

c. Recommended basic flight modes for Back course (BCRs) Localizer approach are LANV/ VNAV Path. For final course intercept H/D SEL, H/D Hold, TRK SEL or TRK Hold may be used if needed.

d. Fpr Back course (BCRs) Localizer Approach, LOC/APP Mode on MCP is not available.

e. Procedures

1) FMC set up: Select appropriate Back course (BCRs) Localizer Approach on DEP/ARR page and allow auto tunning.
(BCRs)Localizer Approach를 선택하여 Auto tuning이 되도록 한다.

2) Check LOC Frequency and front course on PFD. (can check also NAV/RDO Page)

3) Select Mode: Select BCRs mode on IFSD (Integrated standby Flight Display) (appropriate airplane)

4) Check raw data: PM must check raw data on ND during Back course (BCRs) Localizer final course approach.

5) Descent procedures: Follow company VNAV approach procedures. If it is not available using VNAV V/S, FPA or FLCH SPD may be used.

6) Others:

a) If crossing Back course Localizer extntion course without ATC instruction, confirme the situation to the ATC.

b) PM must check altitude constraints for each stepdown fix and make standard callouts.

2.15.4 VOR Approach

2.15.4.1 Preparation

a. Passing IAF, confirm proper VOR frequency and course are tuned automatically on the NAV RAD page.
b. If automatic tunning is not available manually input VOR frequency and front course in PF and PM's NAV RADIO Page.
c. Select VOR of VOR/ADF switch on EFIS panel during VOR/VOR DME approach.

2.15.4.2 Approach

a. When intercept heading is given, PF should set MAP mode of ND and PM should select VOR mode and check active route, extended runway center line, CDI center
b. VNAV, V/S, FPA, FLCH are used for pitch mode.
c. LNAV, HDG SEL, TRK SEL are used for roll mode, but LNAV is recommended.
d. When using LNAV, if a course deviation is displayed on VOR CDI, change to HDG SEL or TRK SEL.

2.15.5 NDB Approach

2.15.5.1 Preparation

a. Set NDB frequency on NAV radio page and select ADF of VOR/ADF switch on EFIS panel during NDB Approach.
b. If there is no NDB procedure in FMC data base. Pilot may input similar procedure such as an ILS Approach that is same as that of NDB, with reference to published MAP on NDB approach.

2.15.5.2 Approach

a. Select VOR/ADF switch on the EFIS control panel to ADF.
b. PM shall confirm ADF needle is on course, Selecting ND on EFIS control panel to expanded map mode or centered map mode from 1-2 nm before IAF. PF shall maintain map mode.

c. PF shall continue to use LNAV if it maintains the inbound course precisely and, if not, select HDG/SEL or TRK/SEL to maintain inbound course.
d. Descent can be made using VNAV, V/S, FPA or FLCH, However, VNAV shall not be used when additional waypoint is made which is not included on the profile.
e. PM shall confirm each step down fix altitude and time, and make standard callout.

2.15.6 LDA Approach

a. The Localizer type Directional Aid (LDA) is of comparable accuracy to a Localizer, but it is not aligned with the runway.
b. When Glide slope information is not received Localizer only approach will be approved starting from FAF within 10NM of runway threshold.
c. Straight-in minimums will be applied where alignment does not exceed 30° between the approach course and runway. Circling minimums will be applied where alignment exceeds 30°.
d. Localizer whose alignment is within 3° of runway is identified as Localizer and localizer whose alignment exeeds 3° is identified as LDA facility.
e. When alignment exceeds 6° back course LDA is not approved.
f. Some kinds of LDA approach provides a glide slope information. In this case, “LDA/Glide slope” is depicted on the approach chart, and because the final approach course is not aligned with the runway, compared to the ILS approach, a corrective maneuvering is required for alignment.

2.15.7 SDF Approach

a. Basically, SDF (Simplified Directional Facility) is similar to ILS Localizer Approach but it is less accurate.
b. Final course of SDF is not aligned with the runway. SDF antenna offsets runway centerline, generally offset angle is not greater than 3degrees.

c. Usable off-course indications are limited to 35 degrees either side of the course centerline. Instrument indications received beyond 35 degrees should not be used.
d. Identification consists of a three-letter identifier transmitted in Morse Code.

2.15.8 RNAV Procedure

a. It is defined as a method of "Waypoint to Waypoint" navigation that allows operation on any desired course within the coverage of station service volume or within the limits of a self-contained navigation system capability, or combination of these two methods.
b. RNAV navigation does not require any track directly to or from any specific radio station, and allows an airplane to fly on given airways within the limits.
c. RNAV is applicable of flying the airplane into terminal areas on arrival and departure paths as well as cruising along the airway.
d. For more information on other approach procedures, refer to the chapter 7. "Normal Operation Procedure" in the FOM.

2.15.9 GPS (Global Positioning System) Approach

Use LNAV, VNAV (or V/S) mode and it is similar to VOR/VOR DME approach.

a. Before initiating approach check if GPS operates normally in POS page of FMC and if necessary check RNP/ANP in FMC POS 2/3.
b. When GPS position is in doubt position must be verified using available method. Independent GPS approach is not approved in the place where WGS-84 is not used.
c. LNAV is used as roll mode, and VNAV or V/S is used as pitch mode. In addition, it is similar to VOR/VOR DME approach

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2.18 Visual Approach

2.18.1 General

2.18.1.1 Preparations

a. Check the weather at the destination airport and ensure it has appropriate ceiling and visibility to maintain a visual pattern.
b. FMC ARRIVAL Page is useful to maintain 2NM downwind width by selecting Runway and RWY EXT.
c. Usually radar vectored to the airport of downwind leg or final approach and maintain visual reference for landing.

2.18.1.2 Initial/Intermediate Approach

a. The pilot reports runway in sight or visual reference to ATC then requests visual approach clearance for landing.
b. Enter maneuvering on downwind leg using HDG/TRK mode when cleared ATC.
c. Maintain flaps 5 before entering on downwind at Flap 5 maneuvering speed
d. Refer to FMC and ND for downwind width and base turn point if available.

2.18.1.3 Downwind and Base

a. Maintain 1,500FT AGL and 2NM according to wind condition on the downwind leg.
b. Prior to turning base, and 30 seconds past end of the runway extend the landing gear, select flaps 20, arm the speedbrakes, and slow to flaps 20 maneuvering speed.
c. Approximately 40~45 seconds past end of the runway start base turn with shallow descent rate.
d. Select landing flaps (flaps 25 or flaps 30) then LANDING CHECKLIST at base.
e. At turning final, PF orders PM to set the runway heading.
   1) PF : “Set Runway Heading”
   2) PM : “Runway Heading Set”

2.18.1.4 Final Approach

a. Recommended approach path approximately 2 1/2~3 degrees.
b. Adjust the point and bank angles for entering final considering wind direction.
c. An altitude of approximately 300 feet above airport elevation for each mile from the runway provides a normal approach profile.
d. Stabilize the airplane on the selected approach speed with an approximate rate of descent between 700-900 FPM. Descent rate greater than 1000 FPM should be avoided. However, little over 1,000FPM is acceptable when heavy gross weight or three VASI condition and it should be included in approach briefing.
e. Stabilize the plane by 500FT (HAT) on final, Execute "GO-AROUND" if unable to stabilize.
f. PM should callout "FIVE HUNDRED", PF should response "LANDING" or "STABILIZED" at 500FT (HAT).

2.18.1.5 Go-Around

a. Execute missed approach if un-stabilized approach, lost visual reference or ATC directions.
b. Accomplish normal go-around procedure by maintaining runway heading or ATC instructed heading.

2.18.2 CVFP (Charted Visual Flight Procedures)

a. Some Airport (e.g:SFO) operate CVFP (Charted Visual Approach Procedures) which permit a higher volume of air traffic during good weather conditions and to minimize feul, reduce flight time.

b. Pilot may accept clearance for a CVFP in the following circumstances.

1) Remains in a radar environment and has an operating tower.

2) Remains clear of cloud and operate in accordance with the published CVFP procedure and minima.

c. If followed by another aircraft, the flight crew accepts responsibility for wake turbulence and safe landing separation from the aircraft.

d. If the crew does not have visual contact with the preceding aircraft, ATC may still clear the CVFP but retains responsibility for both aircraft and wake turbulence separation.

WARNING

If unsatisfied by the above circumstances, pilot should execute Go-Around.

2.18.3 Side Step Maneuver

A visual maneuver accomplished by a pilot at the completion of an instrument approach to permit a straight-in landing on a parallel runway not more than 1,200FT to either side of the runway to which the instrument approach was conducted.

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2.19 Missed Approach (Go-around) Procedure

2.19.1 Missed Approach-All Engines Operating

2.19.1.1 Decision and Control

a. The decision to make a missed approach rests with the Captain. However, when Co-pilot (F/O) flies the aircraft as PF, Co-pilot (F/O) can make a missed approach.
b. In the event of go-around when Co-pilot (F/O) flies the aircraft as PF, Co-pilot (F/O) must maintain positive control of the aircraft until captain takes over the control saying "I HAVE CONTROL".
c. Refer to this chapter "stabilized Approach" for the conditions of Missed Approach (Go-Around) in this POM.

2.19.1.2 Missed Approach during Auto Approach

a. If a missed approach is required following an autopilot approach Leave the autopilot engaged.
b. Push either TO/GA switch, call for flaps 20, ensure go-around thrust for the nominal climb rate is set, and monitor autopilot performance.
c. Retract the landing gear after a "Positive rate of climb" is indicated on the altimeter.
d. If full thrust is desired after thrust for the nominal climb rate has been established, press TO/GA a second time.
e. If touchdown occurs after a go-around is initiated, the go- around continues. However, an automatic go-around cannot be initiated after touchdown.

2.19.1.3 Missed approach during Manual Instrument Approach or Visual Approach

If a missed approach is required following a manual instrument approach or visual approach

a. Push either TO/GA switch, call for flaps 20, check go- around thrust set, and rotate smoothly toward 15 pitch attitude.
b. Then follow flight director commands and retract the landing gear when altimeter indicates "Positive rate of climb"

2.19.1.4 Go-Around Thrust

After TO/GA switch push, observe that the autothrottle apply go-around thrust or manually apply go-around thrust as the airplane rotates to the go-around attitude.

2.19.1.5 TO/GA Pitch Mode

a. The TO/GA pitch mode initially commands a go-around "attitude" and then transitions to "speed" as the rate of climb increases.
b. This speed is normally between command speed and command + 25 knots.

2.19.1.6 TO/GA Roll Mode

a. The TO/GA roll mode maintains existing ground track.
b. When a roll mode is selected as appropriate above 400FT (AGL), follow selected roll mode.

Note)

1. *Selection of pitch and roll mode below 400FT (AGL) does not change the autopilot and flight director modes.*
2. *Automatic LNAV Engagement Functions of HL7775 – HL8254*
   a) Manual Flight: automatically activates above 50 ft RA.
   b) Auto Flight: automatically activates above 200 ft RA

2.19.1.7 Flaps Retraction Altitude

a. The minimum altitude for flap retraction during a nomal takeoff or an altitude concerned noise abatement procedure is not nomally applicable to a missed approach.
b. Use 1,000ft (AGL) to initiate acceleration for flap retraction and obstacles in the missed approach path must be taken into consideration.

2.19.1.8 Maneuvering

a. If initial maneuvering is required during the missed approach, retract landing gear before initiating the turn.
b. Delay further flap retraction until initial maneuvering is complete and a safe altitude and appropriate speed is attained.

2.19.1.9 Command Speed

a. Command speed should not be increased until a safe altitude or flap retraction altitude is attained.
b. Accelerate to flap retraction speed (VREF + 80) or airport specified holding speed by repositioning the command speed to the maneuvering speed for the desired flap setting.
c. Retract flaps on the normal flap speed schedule.
d. When the flaps are retracted and the airspeed approaches maneuvering speed, select FLCH and ensure that CLB thrust is set.

2.19.1.10 Use of VNAV

a. Delay use of VNAV until appropriate FMC entries are completed.
b. If VNAV is used during go-around, premature level off may occur and Selection of FLCH may be required to complete the climb to the missed approach altitude.
c. Speed intervention may also be required to set the appropriate speed.

2.19.2 Missed Approach- One Engine Inoperative

2.19.2.1 One Engine Inoperative and TAC Inoperative

a. The missed approach with an engine inoperative should be accomplished in the same manner as a normal missed approach except use flaps 5 for the go-around flap setting for a flaps 20 approach or use flaps 20 as the go-around flap setting for a flaps 25 or 30 approach. However, speed increase must be initiated at engine out acceleration height applied to the airport.
b. After TO/GA is engaged, the AFDS commands a speed that is normally between command speed and command speed +15 knots.
c. If accomplishing a manual go-around, the pilot must control yaw with rudder and trim. Some rudder pedal pressure may be required even with full rudder trim
d. Select maximum continuous thrust when flaps are retracted.
e. For a multi-autopilot go-around, yaw is initially controlled by the autopilots. Be prepared to apply rudder input immediately when selecting another roll mode, pitch mode, or when altitude capture occurs above 400ft(AGL) because the autopilot reverts to single autopilot operation. The system reverts to normal autopilot operation and automatic control of rudder is discontinued.

2.19.2.2 One Engine Inoperative and TAC Operative

a. When making a missed approach with TAC operating, the rudder is automatically positioned to compensate for differential thrust with minimal input required from the pilot.
b. Unlike the condition when TAC is inoperative, TAC continues the rudder control when the airplane transitions to a new lateral or vertical mode.

2.19.2.3 One Engine Out Missed Approach

a. Considerations for Missed Approach

1) In case that one engine inoperative procedure is established, follow the one engine inoperative procedure.
2) In case that one engine inoperative procedure is not established, make straight out departure.
3) Advise ATC of pilot's intention at or above 400ft AFE.

2.19.2.4 Procedure

a. Push either TO/GA switch.
b. Set flaps 5 or flaps 20.
c. Rotate smoothly toward a G/A pitch attitude (manual G/A) or monitor autopilot go-around
d. Ensure the G/A thrust is set.
e. Retract the landing gear after a 'Positive rate of climb' is indicated on the altimeter.
f. At 400ft(AFE), engage any roll mode (LNAV, HDG SEL / TRK SEL).
g. Set VREF+80kts at flap retraction altitude.
h. If a different flap retraction altitude is specified for the landing runway to ensure obstacle clearance, initiate flap retraction at that altitude.
i. When the flaps are retracted and the airspeed approaches flaps up maneuvering speed, select FLCH and ensure CLB thrust is set.
j. Complete the AFTER TAKEOFF checklist.

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2.20 Landing

2.20.1 General

Landing is phase between entering final approach course and clearing the runway. This phase is the most importance phase, so crew should do the best and perform the standard procedures and callouts.

2.20.2 Landing Speed Addition

2.20.2.1 Vref Select

a. When normal approach, pilot should select Vref 30 (or Vref 25) Speed in approach REF PAGE.
b. When non-normal situations, pilot should select FLAPS by the Non normal checklist.

2.20.2.2 Command Speed

a. When Using Autothrottle

1) Set command speed to VREF+5knots.
2) Sufficient wind and gust protection is available with autothrottle engaged because the autothrottle adjusts the approach speed upward to account for the gusts actually encountered during the approach.
3) In turbulence, the result is that average thrust is higher than necessary to maintain command speed. This results in an average speed exceeding command speed.

b. When not Using Autothrottle

1) If the autothrottle is disengaged, or to be disengaged prior to landing, the recommended method for approach speed correction is to add one half of the reported steady headwind component plus the full gust increment above the steady wind to the reference speed.
2) When making adjustments for wind additives, the maximum command speed should not exceed VREF+20kts.

<Examples>

Example of wind additives with a runway heading of 360°

Reported Wind	Wind Additive	Approach Speed
360 / 16knots	8	VREF + 8knots
Calm	0	VREF + 5knots
360/20 Gust 30knots	10+10	VREF + 20knots

3) MPS (Meter per second) multiplied by 2 makes knots.

4)The minimum command speed setting with autothrottle disconnected is VREF+5kts.

5) The gust correction should be maintained to touchdown while the steady headwind correction should be bled off as the airplane approaches touchdown.

Note) Do not apply wind corrections for tailwinds. Set command speed at VREF + 5 knots.(autothrottle engaged or disengaged)

c. Non-Normal Conditions

1) When VREF has been adjusted by the non-normal procedure, the new VREF is called the adjusted VREF and becomes the VREF for landing. (Adjusted VREF does not include wind corrections)

2) If a non-normal checklist specifies “use flaps 20 and VREF30+20 for landing”, the flight crew would select flaps 20 as the landing flaps and look up the VREF 30 speed in the FMC or QRH and add 20 knots to that speed.

3) When not using the autothrottle, appropriate wind corrections must be added to the adjusted VREF to arrive at command speed, the speed used to fly the approach. For example, if the checklist states “use VREF30+20 knot”, command speed should be positioned to adjusted VREF (VREF30+20) + wind correction (5 knots minimum, 20 knots maximum).

Note) Adjusted Vref for Non-Normal Configuration should be maintained until touchdown..

2.20.3 Decision to Land

2.20.3.1 Reponsebilities

During instrument approaches, the captain has a primary responsibility to make a decision to continue to a landing or to execute missed approach..

2.20.3.2 Decision Point

a. Decision to land is to made at correct time. The decision must be made no later than MDA or certified minimum altitude.
b. The decision points are as follows:
   1) Precision approach: DA (H) or AH
   2) Non precision approach: MDA
c. The captain (PF) shall make callout intentions at decision points, so that other flight crews (Co-pilot (F/O) and Assistant crew if onboard) acknowledge the captain's intention.

2.20.4 Flare

2.20.4.1 Auto Landing

a. Flare mode is engaged at 50FT (40FT~60FT in accordance with SINK RATE).
b. At 25~50 ft RA, thrust is slowly decreased to idle and A/T annunciation changes SPD into IDLE.

2.20.4.2 Manual Landing

a. Initiate the flare when the main gear is approximately 20ft above the runway by increasing pitch attitude approximately 2~3 degrees
b. Do not increase pitch attitude continuously after initiating flare
c. During flare, avoid floating and drift
d. When Co-pilot (F/O) is flying the airplane, the captain should put his feet and hands lightly on the control wheel, rudder, thrust lever in order to immediately guard the aircraft in case of non-normal situations or inappropriate action by Co-pilot (F/O) below 500FT AFE during approach.

2.20.5 Touch Down

a. After passing threshold, airplane touches down at speed of VREF + GUST factor between 1,000FT~2,000 down the threshold.
b. Airplane body attitudes are 4°~5°based upon typical landing weights, flaps 30, VREF 30 + 5 (approach) and VEF 30 + 0 (landing), and should be reduced by 1 degree for each 5knots above this speed.

2.20.6 After Touch Down

2.20.6.1 General

a. After main gear touchdown, initiate the landing roll procedure.
b. Fly the nose wheel onto the runway smoothly by relaxing aft control column pressure.
c . Holding the nose up after touchdown for aerodynamic braking is not an effective braking technique.
d. When an auto landing is accomplished, the autopilot should be disengaged before vacating the runway.
e. In principle, manipulate equipment that related to items of AFTER LANDING checklist after vacating the runway.

2.20.6.2 Use of Spoilers

a. During landing when the main gear contacts the ground and nose gear on it's way down, check speedbrake lever is in the up position and auto spoiler deployed.
b. If auto spoiler is not fully extended, PM calls out "SPEEDBRAKES NOT UP." and immediately deploy speed brakes manually.

2.20.6.3 Wheel Brake Operation

a. PF

1) Use an appropriate autobrake setting or manually apply wheel brakes smoothly with steadily increasing pedal pressure as required for runway condition and runway length available.
2) Inform the PM calling out "Manual brake" when switch to manual brake.
3) Maintain deceleration rate with constant or increasing brake pressure as required until plane stops or reach drsired taxi speed, and use the nose wheel steering tiller when taxi speed is reached

b. PM

1) If autobrake has been set in advance, confirm that autobrake is working by checking out the EICAS DISPLAY and the AUTOBRAKE SELECTOR.
2) If 'AUTOBRAKE' EICAS MESSAGE is displayed on the EICAS DISPLAY after the PF called out "Manual Brake" applying the brakes manually, check 'AUTOBRAKE' EICAS MESSAGE displayed, and then call it out.

2.20.6.4 Thrust Reverser Operation

a. PF

1) After touchdown, with the thrust levers at idle, rapidly raise the reverse thrust levers up and aft to the interlock position, and then maintain light pressure on the interlock.
2) After the interlock is released, apply reverse thrust until the airspeed approaches 60kts.
3) Start reducing reverse thrust at 80knots and be at Idle detent by 60KIAS, only if braking effectiveness is good and sufficient runway length remains.
4) On the slippery runway, maintain reverse thrust at the idle detent position to use it again in case of emergency.
5) After the reverse thrust have decelerated to idle, position the reverser levers to full down.

6) Stow thrust reverser, when exiting runway by using HST (high speed taxiway).
7) If an engine surges during reverser thrust operation, quickly select reverse idle on both engines.
8) If the runway is dry and good condition it is recommended that use idle reverse thrust

Note

1. Advantages of using idle reverse thrust after landing on dry good runway.

a) saving fuel

b) extend wheel brakes life

c) Passenger comfortable

d) take advantage under abnormal reverser thrust operation (asymmetry operation)

2. When land on other than dry good runway, wheel brakes efficiency decrease due to anti skid system operation,reverse thrust must be used higher than idle.

b. PM

1) If the PF applies reverse thrust, check 'REV (AMBER)' on the EICAS DISPLAY changed to 'REV (GREEN)' and then call out "REVERSERS NORMAL".
If there is no REV indication(s), or the indication(s) stay amber, call "NO REVERSER LEFT/RIGHT ENGINE" or "NO REVERSERS".
2) As the airspeed decreases, call out "80kts" and "60kts" to assist the PF in scheduling the reverse thrust operation.
3) Monitor engine operating limits and call out any engine operational limits being approached or exceeded, any thrust reverser failure, or any other abnormalities.

The end of section

2.23.2.5 After Takeoff

PF	PM
"After Takeoff Checklist" →	"After Takeoff Checklist"
"Checked"	←"Checklist Complete"

2.23.2.6 Climb

PF	PM
"Checked"	← " 10,000 (One Zero Thousand)" (Verify Silently) - Turn all exterior lights off (except beacon, NAV, Logo(Night), strobe) - Position NO SMOKING selector to AUTO - Check Synoptic(ENG,AIR)
"Set Standard"	← "Transition"
(Verify passing altitude) "Checked"	← "Standard Set" (Verify passing altitude)
"Checked"	← "1,000 to Level Off"
"Checked"	← "SPD, VNAV PTH"(FMA)

2.23.2.7 Descent & Approach

PF	PM
"Descent Checklist" →	"Descent Checklist"
"Checked"	← "Checklist Complete"
"Checked"	← "10,000 (One Zero Thousand)" (Verify And Silent) - Turn all exterior lights ON
"Set QNH(QFE) 0000"	← "Transition"
(Verify passing altitude) "Checked"	← "QNH(QFE) 0000 Set" (Verify passing altitude)
"Approach Checklist" →	"Approach Checklist complete"

PF	PM
"Checked"	←"Checklist Complete"
"Checked"	← "1,000 to Level Off"
"Checked"	← "1,000 to Level above initial"
"Flaps 1" →	"Speed Check Flaps 1 Set"
"SPD 000 set"	"Checked"
"Flaps 5" →	"Speed Check Flaps 5 Set"
"SPD 000 set"	"Checked"
"Checked"	← "Localizer Alive"
"Checked, Approach Mode"	← " I (code name) Identified
"Checked"	← "Localizer & Glide Slope Armed"
"Checked"	← "Localizer Captured"
"Checked"	← *"RA alive"
"Gear Down, Flaps 20" →	← "Glide Slope Alive" "Gear Down, Speed Check Flaps 20 Set"
"SPD 000 set"	"Checked"
"Flaps 30" →	← "Glide Slope Captured" "Speed Check Flaps 30 Set"
"SPD 000 set"	"Checked"
"Set Missed Approach Altitude" or Missed Approach altitude set	"Missed Approach Altitude Set or checked"
"Landing Checklist" → "Check list complete clear to land (or continue approach) RWY OO L/R"	"Landing Checklist" ← "Landing Checklist Complete Clear to land (or continue approach) RWY OO L/R"
"LAND 3 (2)	← "Rollout, Flare Armed"

* After RA alive, PM should monitor RA reading until landing for flight crew awareness.

2.23.2.8 Passing OM (Outer Marker) or FAF

PF	PM
"Checked"	← "OM or FAF, __FT,"

2.23.2.9 1,000FT to & 500Ft (AFE)

PF	PM
"Stabilized" or "Go-Around" (IMC) "Checked" (VMC)	← "1,000" (One Thousand) *If no acknowledge after twice callout take over the Aircraft Control*
"Stabilized"or Go-Around"	← "500" (Five Hundred) *If no acknowledge after twice callout take over the Aircraft Control*
	Call out significant deviations

2.23.2.10 Approaching Minimum or Below

PF	PM
"Checked"	(At 100FT Above Minimum) ← "Approaching Minimum"
"Checked" (Landing or Go-Around)	← "Strobe Lights or Approach Lights or Center Line Lights or Runway Light In-Sight
"Landing or Go-Around"	At Minimum ← "Minimums" (Auto Call Monitor Only)
	Call out significant deviations

Note)

1. *PF should be performed Transit to visual flight (refer to the scan policy) prior to arriving at Approach Minimum (except CAT-III with AH).*
2. *For more details of "scan policy", refer to the chapter 2 in this POM.*

3. It is sole responsibility to final determine landing before descent below DA (H) or MDA (H).

When the Co-pilot (F/O) conducts a landing as a PF,
(s)he will callout "Landing" or "Go Around" at minimum.
At that time if landing is assured captainalso call out "Landing" or call "Go Around" if landing is not safe and take over aircraft controls.

2.23.2.11 Missed Approach (Go-Around)

PF	PM
"Go Around"	
"TO/GA (TO/GA S/W PUSH), Flaps 20" →	"TO/GA (Verify FMA), Flaps 20 Set"
"Gear Up" →	← "Positive Rate" "Gear Up"
LNAV (HDG SEL) →	← "400 " (AFE) LNAV (or HDG SEL)
"Set VREF + 80" →	← "1,000" (AFE) if specific procedure is established, call out the altitude concerned. VREF + 80 Set
"Flaps 5" →	"Speed Check Flaps 5 Set"
"Flaps 1" →	"Speed Check Flaps 1 Set"
"Flaps Up" →	"Speed Check Flaps Up Set"
"VNAV or FLCH" →	"VNAV or FLCH" (FMA)
"After Takeoff Checklist" →	"After Takeoff Checklist"
"Checked"	←"Checklist Complete"

Note; When the Co-pilot (F/O) conducts as a PF, (s)he maintain aircraft controls until captain take over controls

2.23.2.12 Landing Roll

PF	PM
Verify Callout Items	← "SPEEDBRAKES UP" or "SPEEDBRAKES NOT UP"
	← "REVERSERS NORMAL" or "NO REVERSER LEFT ENGINE" or "NO REVERSER RIGHT ENGINE" or "NO REVERSERS (REV indication amber)".
"Checked"	← "80Knots"
"Checked"	← "60Knots"
"Manual Brakes" →	"Autobrake"(Check EICAS Message)
	Advice taxiway & other information

2.23.2.13 Taxi In

PF	PM
"After Landing Checklist" →	"After Landing Checklist"
"Checked"	←" Checklist Complete"

2.23.2.14 Parking & Engine Shut Down

Captain	Co-pilot (F/O)
"Shut Down Checklist" →	"Shut Down Checklist"
"Checked"	←" Checklist Complete"
"Secure Checklist" →	"Secure checklist"
"Checked"	←" Checklist Complete"

2.23.2.15 Instruction Items of ATC

Phase	PF	PM (Readback)
Heading	"Heading 270"	←"Right Turn Heading 270"
Altitude	"FL160"	←"Descend and Maintain FL160"
Airspeed	Speed 250	← "Reduce Speed to 250Knots"
Restrictions	" 10,000, Speed 230 at SEL"	←"Cross SEL VOR at or Below 10,000FT & Speed 230Knots"
Taxi	"Runway 33L Via A5"	←"Taxi to Runway 33L Via A5"
	"Holding short of 33L"	←"Holding short Runway 33L"
	"Crossing runway 33L"	←"Cleared crossing Runway 33L"
Takeoff	"Cleared for takeoff 33L"	←"Cleared for Takeoff Runway 33L"
Landing	"Clear to land 33R"	←"Cleared to Land Runway 33R"

2.23.2.16 Thrust, Roll and Pitch Mode Change on PFD

PF	PM
"Checked"	← "Thrust Ref"
"Checked"	← "VNAV Speed"
"Checked"	← "Speed altitude"
"Checked"	← "Hold, VNAV Path"

2.23.3 Non-ILS Approach

2.23.3.1 Approach using V/S

a. Manual Flight

Situations	PF	PM
1~2NM From IAF (Level Flight)	"Checked"	← "Approaching IAF(or Name of IAF) Next ___DME, 0000 FT" Check ND at VOR Mode
	"Set Next ALT 0000 Ft & V/S →	Next ALT 0000 Set, V/S Engaged"
IAF	"Set V/S Minus 000 " →	← "IAF, 00 DME, Next___ DME, 0000 Ft" V/S 000 Set
FIX	"Set Altitude Feet	← Approaching DME, Next DME 0000Feet. "Altitude000Feet Set"
FAF	"Set MDA000" →	← ← Approaching FAF (Approximately 2 NM) "MDA 000 Set
	"Checked"	← "Over FAF, 0000 Ft"
1,000FT (AFE)	Stabilized" or "Go-Around"(IMC) "Checked"(VMC)	← "1,000" (One Thousand)
500FT (AFE)	"Stabilized" or "Go-Around"	← "500" (Five Hundred)
Approaching MDA	"Set Missed Approach Altitude" →	(At 300 Feet above MDA) ← "Approaching MDA" "Missed Approach Altitude 0000 Set"
MDA(MAP)	"Landing or Go-Around" →	"Checked"

b. Auto Flight

Situations	PF	PM
1~2NM From IAF (Level Flight)	"Checked"	← "Approaching IAF(or Name of IAF) Next ___DME, 0000 FT"
	"Next ALT 0000FT Set & V/S →	"Checked, V/S Engaged"
IAF	"V/S Minus 000Set" →	← "IAF, 00 DME, Next___DME, 0000 FT" "Checked"
FIX	"Checked, "Next Altitude 0000 Set →	← Approaching DME, Next DME 0000Feet. "Checked"
FAF	"MDA000 Set" →	← Approaching FAF "Checked"
	"Checked"	← "Over FAF, 0000FT"
1,000FT (AFE)	"Stabilized" or "Go-Around" (IMC) "Checked"(VMC)	← "1,000" (One Thousand)
500FT (AFE)	"Stabilized" or "Go-Around"	← "500" (Five Hundred)
Approaching MDA	"Set Missed Approach Altitude" →	(At 300 Feet above MDA) ← "Approaching MDA" Missed Approach Altitude 0000 Set"
MDA (MAP)	Landing" or Go-Around →	"Checked"

2.23.3.2 Approach using VNAV

Situations	PF	PM
2NM From FAF		← "Approaching FAF (or "Approaching Glide Path")
	"MDA 000 Set " →	"Checked"
Prior to reaching FAF	"VNAV" → "Checked" "Speed 000 Set"→	← "SPD VNAV PTH" "Checked"
	"Checked"	← "FAF, 0000 ft,"
300 feet below Missed Approach Altitude	"Set missed approach altitude" →	"Missed approach altitude set"
1,000FT (AFE)	"Stabilized" or "Go-Around" (IMC) "Checked"(VMC)	← "1,000" (One Thousand)
500FT (AFE)	"Stabilized" or "Go-Around"	← "500" (Five Hundred)
100 FT Above MDA(MAP)	"Checked"	← "Approaching Minimum"
At MDA	"Landing or Go around"	"Minimum"

2.23.3.3 Circling/Visual Approach

Situation	PF	PM
100FT Above MDA	"Checked"	←"Approaching Minimum"
MDA	"Runway In-Sight" "Set Missed Approach ALT 0000"	"Missed Approach ALT 0000 Set"
Turning to the Downwind	"R/H (L/H) Turn HDG 000" →	"Checked"
Passing End of Runway	"Time Check 00 Seconds" Flaps 30 (Landing Flaps)" →	"Speed Check Flaps 30 Set"
	"Landing Checklist" → "Check list complete clear to land (or continue approach) RWY OO L/R"	"Landing Checklist" ← "Landing checklist complete clear to land (or continue approach) RWY OO L/R"
500FT	"Stabilized or G0-Around"	500 (Five Hundred)
300FT (If necessary)	"Stabilized or G0-Around"	"300 (Three Hundred)"

2.23.4 Standard Callouts for abbreviations and symbols

PHRASE	CALLOUTS
AP	“AUTO PILOT”
FD	“FLIGHT DIRECTOR”
LOC	“LOCALIZER”, “LOC”
G/S	“GLIDE SLOPE”
HDG	“HEADING”
RWY	“RUNWAY”
TRK	“TRACK”
GA TRK	“GO-AROUND TRACK”
SPD	“SPEED”
MACH.76	“MACH POINT SEVEN SIX”
ALT	“ALTITUDE”, “ALT”
FL	“FLIGHT LEVEL”
FLCH	“FLIGHT LEVEL CHANGE”
CLB	“CLIMB”
DES	“DESCEND”
IAF	“INITIAL APPROACH FIX”
FAF	“FINAL APPROACH FIX”
IF	“INTERMEDIATE FIX”
FINAL APP	“FINAL APPROACH”
VREF	“VREF”
NAV	“NAV”
LNAV	“LNAV”
VNAV	“VNAV”
RNAV	“RNAV”
TOGA	“TOGA”
MAP	“MAP”
DA	“DA” or “DECISION ALTITUDE”
DH	“DH” or “DECISION HEIGHT”
MDA	“MDA” (Alphabetic reading)
RA	“RA” (Alphabetic reading)
10,000FEET	“ONE ZERO THOUSAND”
1,000FEET	“ONE THOUSAND”

500FEET	“FIVE HOUNDRED”
100KNOTS	“ONE HUNDRED KNOTS”
1,000 FEET Above / Below assigned Altitude or Flight Level.	“ONE THOUSAND TO LEVEL OFF” or “ONE THOUSAND TO GO”
+	“AND”
*	“STAR”

The end of section

Table of Contents

The end of section

6.1 General

6.1.1 Basic Empty Weight (BEW)

MEW (Minimum Empty Weight) plus or minus (+/-) weight of standard item.

6.1.2 Standard Items

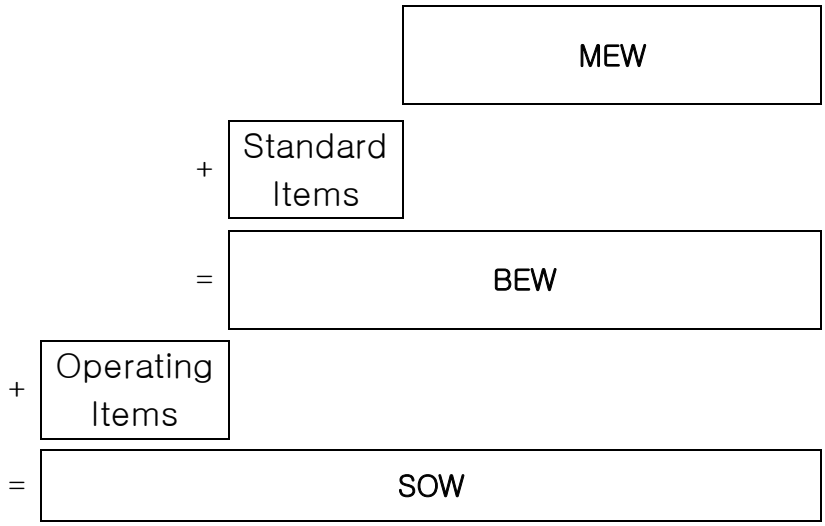
Equipment and system fluids not considered an integral part of a particular aircraft configuration. (Typically does not vary within a model type)

6.1.3 SOW or OEW

SOW (Standard Operating Weight) or OEW (Operational Empty Weight) = BEW plus operational items - may be different according to operational route.

6.1.4 Operating Items

Personnel, equipment and supplies necessary for a particular operation that is not included in basic empty weight.



6.1.5 Balance Arm (B.A)

Balance Arms are a true distance in inches from the reference origin which is located 98 inches fwd of the airplane nose.

6.1.6 Mean Aerodynamic Chord (MAC)

a. Length of the MAC is 278.5 in.
b. The Balance Arm of Leading Edge of the MAC is 1174.5 inch

6.1.7 % MAC

$$CG\ \ \%MAC\ = \frac{(ARM\ \ (Inch) - 1174.5)}{278.5} \times 100$$

6.1.8 Index Unit Equation

$$I.U. = \frac{[WT\ \ (lb) \times (ARM\ \ (Inch) - 1258)]}{400{,}000} + 50$$

The end of section

6.2 Seat Configuration

Fwd Cabin	Mid Cabin	Aft Cabin	Total
32 (1 ~ 5 row)	157 (10~28 row)	114 (29~42 row)	32C/271Y 303
28 (1 ~ 4 row)	157 (10~28 row)	114 (29~42 row)	28C/271Y 299

For seat configuration applicability, refer to load sheet or OFP

The end of section

6.3 How to Use Weight & Balance Manifest

6.3.1 Title

Flight Number	Reg. Number	Date
OZ 272	HL7756	03/06/09

From	To
ICN	SEA

a. Flight Number : Flight Number of Operational Route
b. Reg. Number : Registration Number of Aircraft
c. Date : Date of Flight
d. From : Departure Station
e. To : Arrival Station

6.3.2 Operating Weight Calculation

Description		Weight						I.U.
1	Standard Operating Wt	3	2	0	0	0	0	+37.5
2	Adjustments to Crew & Service Items							
3	Operating Wt (1 +/- 2)	3	2	0	0	0	0	+37.5

a. Standard Operating WT (SOW) & Index:
SOW & Index Unit of specific registration number for the given route can be found in the takeoff chart binder (the first page)
b. Adjustments to Crew & Service Item :
Two cockpit crew have been applied to SOW.
Adjustment for extra 1 cockpit crew : 210 pounds & -0.5 Unit
c. Operating weight : Sum of OEW (1) & Adjustment (2)

6.3.3 Total Payload Calculation

Description			Weight						I.U.
4	Fwd Cabin	30 PAX			4	9	5	0	-8.9
	Mid Cabin	150 PAX		2	4	7	5	0	-6.3
	Aft Cabin	110 PAX		1	8	1	5	0	+23.2
5	Fwd1 Hold				8	5	0	0	-14.9
	Fwd2 Hold			1	1	0	0	0	-11.2
	Aft1 Hold				5	5	0	0	+4.6
	Aft2 Hold			1	8	5	0	0	+22.6
	Bulk Hold				1	5	0	0	+2.6
6	Total Payload (4 + 5)			9	2	8	5	0	+11.8

a. Passenger Information
Standard Passenger Weight :
165 pounds/ adult & 82 pounds/ child (For International Flight)
160 pounds/ adult & 80 pounds/ child (For Domestic Flight)
22 pounds/ infant (for International and Domestic)
Passenger Index Unit : Table was given on the rear page

b. Cargo Loading Information
Cargo Weight : Actual Weight of cargo zone
Cargo Index Unit : Table was given on the rear page

c. Total Payload
Sum of Total Passenger & Cargo Weight

6.3.4 Zero Fuel Weight Calculation

Description		Weight						I.U.
7	Zero Fuel Wt (3 + 6)	4	1	3	1	5	0	+49.3

a. Summation of Operating Weight (3) & Total Payload (6)

6.3.5 Takeoff Fuel Calculation

Description			Weight						I.U.
8	Fuel	Ramp	2	0	1	0	0	0	
		Taxi –			1	0	0	0	
		Takeoff	2	0	0	0	0	0	-4.1

a. Ramp Fuel : Fuel weight before Taxi
b. Taxi Fuel : 1,000 pounds of fuel expect to be consumed during taxi
c. Takeoff Fuel : Ramp Fuel minus Taxi Fuel
d. Fuel Index Unit : Table was given on the rear page

6.3.6 Takeoff Weight Calculation

Description		Weight						I.U.
9	Takeoff Weight (7 + 8)	6	1	3	1	5	0	+45.2

a. Summation of Zero Fuel Wt (7) & Takeoff Fuel (8)

6.3.7 Last Minute Change Adjustment

Description		Weight						I.U.
10	Last Minute Change Adjustment to Payload							
11	Adj. Takeoff Weight							

a. If last minute changes occur, Adjusted Takeoff Weight and Index Unit should be calculated.

6.3.8 Landing Weight Calculation

Description		Weight						I.U.
12	Trip Fuel	1	8	0	0	0	0	
13	Fuel at Landing		2	0	0	0	0	-0.4
14	Landing Weight (7+13)	4	3	3	1	5	0	+48.9

a. Landing Weight

Takeoff weight (9) minus Trip Fuel (12) or Zero Fuel Weight (7) plus Fuel at L/D (13)

b. Landing Weight Index

Zero Fuel Weight index (7) plus Fuel at landing index (13)

6.3.9 Allowable Gross Takeoff Weight Calculation

Max Weight For	Zero Fuel	↓ Take-Off	Landing
	430,000		460,000
Takeoff Fuel +	200,000	Trip Fuel →	+ 180,000
Allowed TOW (Lowest of a,b,c)	a 630,000	b 632500	c 640,000
	630,000		
SOW -	320,300		
Takeoff Fuel -	200,000		
Allowed Traffic Load	109,700		

a. Allowable Gross Takeoff Weight (AGTOW) is the lowest one of following weights.

1) Maximum Zero Fuel Weight plus Takeoff Fuel
2) Maximum Takeoff Weight
3) Maximum Landing Weight plus Trip Fuel

b. Certified Weights are shown in the Manifest.

c. If performance limited weight is lower than Certified Takeoff Weight, fill it out in the max weight for Takeoff (column 'b')

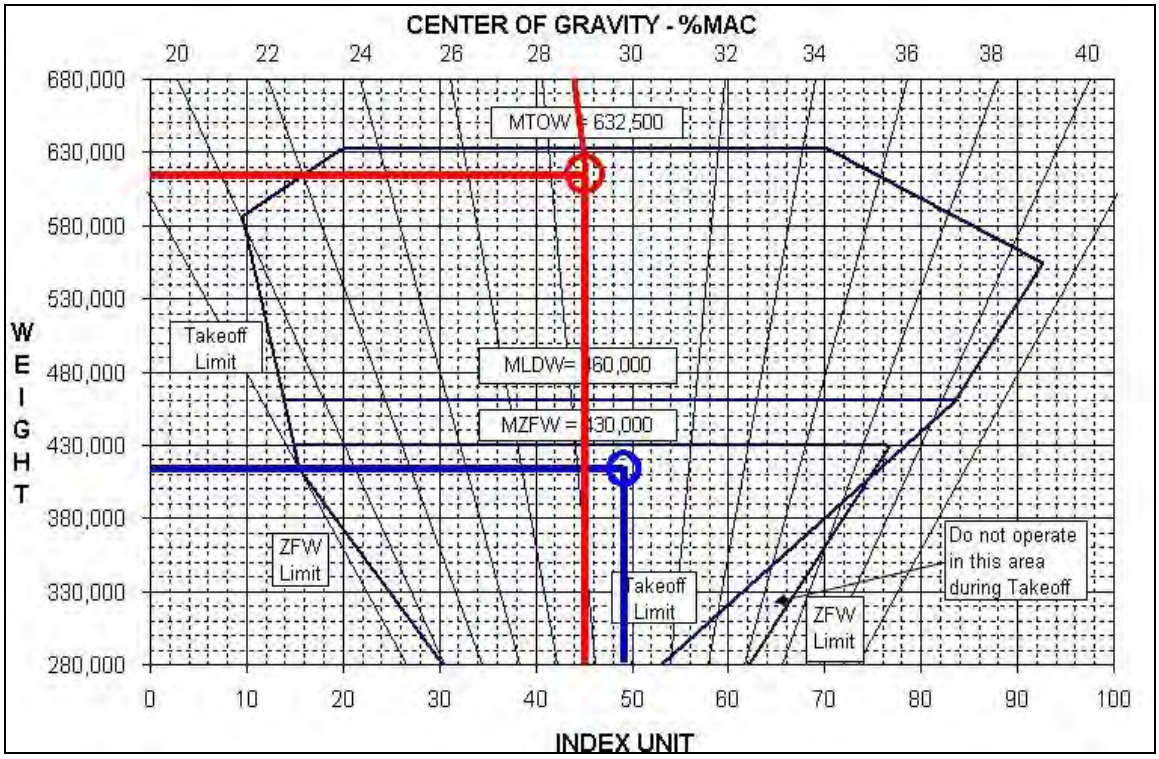
d. Allowable traffic load : AGTOW – SOW – Takeoff Fuel

This shows the maximum allowable payload for the flight.

6.3.10 Center of Gravity Calculation

a. Using Index Unit Equation, CG%MAC can be calculated.
b. Using Check Grid, CG%MAC can be found.
c. Enter the Check Grid, with the Takeoff Weight & Index Unit at takeoff weight.
d. From the point, across the dashed line, CG%MAC can be found.

(Example of CG calculation)



Weight and Balance Manifest

ASIANA AIRLINES

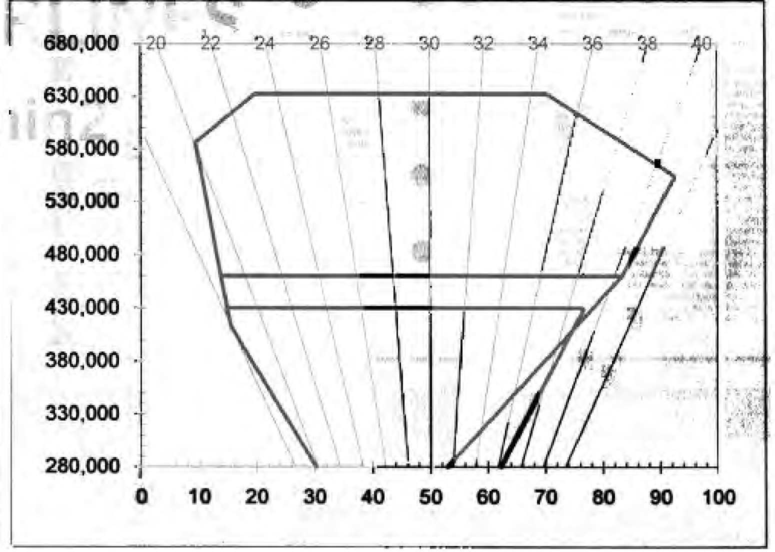
WEIGHT AND BALANCE MANIFEST : B777-200

FLT. NO.	REG. NO.	DATE	FLT Type	FROM	TO	RTOW
	REG. NO.?		FLT Type?			

	Description					Weight	I.U.
1	Standard Operating Weight						
2	Adj. to Cockpit Crew	No of Add Crew	0			-	0.0
	Adj. to Cabin Crew, Service Items						
3	Operating Weight (1±2)					-	0.0
4	No of Pax		Adult	Child	Infant		
	FWD : Max=	0				FLT Type?	0.0
	MID : Max=	0				FLT Type?	0.0
	AFT : Max=	0				FLT Type?	0.0
5	FWD 1 Hold				Max= 33,750		0.0
	FWD 2 Hold				Max= 39,200		0.0
	AFT 1 Hold				Max= 7,000		0.0
	AFT 2 Hold				Max= 28,000		0.0
	BULK Hold				Max= 8,000		0.0
6	Total Payload (4+5)					-	0.0
7	Zero Fuel Weight (3+6)					-	0.0
8	Fuel	Ramp				1,000	
		Taxi				1,000	
		Take Off					#N/A
9	Take Off Weight (7+8)					-	#N/A
10	Trip Fuel						
11	Fuel at Landing (8-10)					-	
12	Landing Weight (7+11)					-	

Allowable Gross Take-Off Weight and Traffic Load Check

	Zero Fuel	Take Off	Landing
Max Weight For	REG. NO.?	REG. NO.?	REG. NO.?
Take-off Fuel	+ -	Trip Fuel → +	-
Allowed WT For T/O	a REG. NO.?	b REG. NO.?	c REG. NO.?
(Lowest of a,b,c)	REG. NO.?		



B777-200ER WEIGHT & BALANCE MANIFEST (Crew Rest Bunk Installed)

Passenger Index Unit Table (All Weights in LBS)

FWD		MID CABIN						AFT CABIN					
Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.
500	-0.9	500	-0.1	10500	-2.7	20500	-5.2	500	+0.6	10500	+13.4	20500	+26.2
1000	-1.8	1000	-0.3	11000	-2.8	21000	-5.3	1000	+1.3	11000	+14.0	21000	+26.8
1500	-2.7	1500	-0.4	11500	-2.9	21500	-5.5	1500	+1.9	11500	+14.7	21500	+27.4
2000	-3.6	2000	-0.5	12000	-3.1	22000	-5.6	2000	+2.6	12000	+15.3	22000	+28.1
2500	-4.5	2500	-0.6	12500	-3.2	22500	-5.7	2500	+3.2	12500	+16.0	22500	+28.7
3000	-5.4	3000	-0.8	13000	-3.3	23000	-5.9	3000	+3.8	13000	+16.6	23000	+29.4
3500	-6.3	3500	-0.9	13500	-3.4	23500	-6.0	3500	+4.5	13500	+17.2	23500	+30.0
4000	-7.2	4000	-1.0	14000	-3.6	24000	-6.1	4000	+5.1	14000	+17.9	24000	+30.6
4500	-8.1	4500	-1.1	14500	-3.7	24500	-6.2	4500	+5.7	14500	+18.5		
5000	-9.0	5000	-1.3	15000	-3.8	25000	-6.4	5000	+6.4	15000	+19.1		
5500	-9.9	5500	-1.4	15500	-3.9	25500	-6.5	5500	+7.0	15500	+19.8		
6000	-10.8	6000	-1.5	16000	-4.1	26000	-6.6	6000	+7.7	16000	+20.4		
6500	-11.7	6500	-1.7	16500	-4.2	26500	-6.7	6500	+8.3	16500	+21.1		
7000	-12.6	7000	-1.8	17000	-4.3	27000	-6.9	7000	+8.9	17000	+21.7		
		7500	-1.9	17500	-4.5	27500	-7.0	7500	+9.6	17500	+22.3		
		8000	-2.0	18000	-4.6	28000	-7.1	8000	+10.2	18000	+23.0		
		8500	-2.2	18500	-4.7	28500	-7.3	8500	+10.9	18500	+23.6		
		9000	-2.3	19000	-4.8	29000	-7.4	9000	+11.5	19000	+24.3		
		9500	-2.4	19500	-5.0	29500	-7.5	9500	+12.1	19500	+24.9		
		10000	-2.5	20000	-5.1	30000	-7.6	10000	+12.8	20000	+25.5		

For Intermediate Values, Use Linear Interpolation.

Fuel Index Unit Table (All Weights in LBS)

Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.
2000	0.0	42000	-0.3	82000	+2.0	122000	+12.7	162000	+6.3	202000	-4.6	242000	-15.4	282000	-26.5
4000	-0.1	44000	-0.2	84000	+2.3	124000	+13.6	164000	+5.7	204000	-5.1	244000	-16.0	284000	-27.0
6000	-0.2	46000	-0.2	86000	+2.6	126000	+14.6	166000	+5.2	206000	-5.7	246000	-16.5	286000	-27.6
8000	-0.2	48000	-0.2	88000	+2.9	128000	+15.6	168000	+4.6	208000	-6.2	248000	-17.0	288000	-28.2
10000	-0.3	50000	-0.1	90000	+3.3	130000	+15.1	170000	+4.1	210000	-6.8	250000	-17.6	290000	-28.9
12000	-0.3	52000	-0.1	92000	+3.6	132000	+14.6	172000	+3.5	212000	-7.3	252000	-18.1	292000	-29.5
14000	-0.3	54000	0.0	94000	+4.0	134000	+14.1	174000	+3.0	214000	-7.8	254000	-18.6	294000	-30.1
16000	-0.3	56000	+0.1	96000	+4.4	136000	+13.6	176000	+2.4	216000	-8.4	256000	-19.2	296000	-30.8
18000	-0.4	58000	+0.1	98000	+4.9	138000	+13.1	178000	+1.9	218000	-8.9	258000	-19.7	298000	-31.4
20000	-0.4	60000	+0.2	100000	+5.4	140000	+12.5	180000	+1.3	220000	-9.4	260000	-20.3	300000	-32.1
22000	-0.4	62000	+0.3	102000	+5.9	142000	+12.0	182000	+0.8	222000	-10.0	262000	-20.8	302000	-32.7
24000	-0.4	64000	+0.4	104000	+6.4	144000	+11.4	184000	+0.2	224000	-10.5	264000	-21.4	302974	-33.1
26000	-0.4	66000	+0.6	106000	+7.0	146000	+10.8	186000	-0.3	226000	-11.1	266000	-21.9		
28000	-0.4	68000	+0.7	108000	+7.6	148000	+10.3	188000	-0.9	228000	-11.6	268000	-22.5		
30000	-0.4	70000	+0.8	110000	+8.2	150000	+9.7	190000	-1.4	230000	-12.1	270000	-23.0		
32000	-0.4	72000	+1.0	112000	+8.9	152000	+9.1	192000	-1.9	232000	-12.7	272000	-23.6		
34000	-0.3	74000	+1.1	114000	+9.6	154000	+8.6	194000	-2.5	234000	-13.2	274000	-24.1		
36000	-0.3	76000	+1.3	116000	+10.3	156000	+8.0	196000	-3.0	236000	-13.8	276000	-24.7		
38000	-0.3	78000	+1.6	118000	+11.1	158000	+7.4	198000	-3.5	238000	-14.3	278000	-25.3		
40000	-0.3	80000	+1.8	120000	+11.9	160000	+6.9	200000	-4.1	240000	-14.9	280000	-25.9		

*Main Tank Full : 128,104 LB for 6.7 LB/USG. For Intermediate Values, Use Linear Interpolation.

Cargo Index Unit Table (All Weights in LBS)

FWD Hold								AFT Hold					
FWD 1				FWD 2				AFT 1		AFT 2			
Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.	Weight	I.U.
1000	-1.8	26000	-45.6	1000	-1.0	26000	-26.5	1000	+0.8	1000	+1.2	26000	+31.8
2000	-3.5	27000	-47.3	2000	-2.0	27000	-27.5	2000	+1.7	2000	+2.4	27000	+33.0
3000	-5.3	28000	-49.1	3000	-3.1	28000	-28.5	3000	+2.5	3000	+3.7	28000	+34.3
4000	-7.0	29000	-50.8	4000	-4.1	29000	-29.6	4000	+3.4	4000	+4.9		
5000	-8.8	30000	-52.6	5000	-5.1	30000	-30.6	5000	+4.2	5000	+6.1		
6000	-10.5	31000	-54.3	6000	-6.1	31000	-31.6	6000	+5.0	6000	+7.3		
7000	-12.3	32000	-56.1	7000	-7.1	32000	-32.6	7000	+5.9	7000	+8.6		
8000	-14.0	33000	-57.8	8000	-8.2	33000	-33.6			8000	+9.8		
9000	-15.8	33750	-59.1	9000	-9.2	34000	-34.7			9000	+11.0		
10000	-17.5			10000	-10.2	35000	-35.7			10000	+12.2		
11000	-19.3			11000	-11.2	36000	-36.7			11000	+13.5		
12000	-21.0			12000	-12.2	37000	-37.7			12000	+14.7		
13000	-22.8			13000	-13.3	38000	-38.7			13000	+15.9		
14000	-24.5			14000	-14.3	39000	-39.8			14000	+17.1		
15000	-26.3			15000	-15.3	39200	-40.0			15000	+18.4		
16000	-28.0			16000	-16.3					16000	+19.6	BULK	
17000	-29.8			17000	-17.3					17000	+20.8	Weight	I.U.
18000	-31.5			18000	-18.4					18000	+22.0	1000	+1.8
19000	-33.3			19000	-19.4					19000	+23.2	2000	+3.5
20000	-35.0			20000	-20.4					20000	+24.5	3000	+5.3
21000	-36.8			21000	-21.4					21000	+25.7	4000	+7.1
22000	-38.5			22000	-22.4					22000	+26.9	5000	+8.8
23000	-40.3			23000	-23.4					23000	+28.1	6000	+10.6
24000	-42.1			24000	-24.5					24000	+29.4	7000	+12.4
25000	-43.8			25000	-25.5					25000	+30.6	8000	+14.1

For Intermediate Values, Use Linear Interpolation.

The end of section

Attachment 10: Related Boeing Guidance & Procedures

LANDING

Speedbrake . . . . . ARMED

Landing gear . . . . . DOWN

Flaps . . . . . ___

Stabilized Approach Recommendations

Maintaining a stable speed, descent rate, and vertical/lateral flight path in landing configuration is commonly referred to as the stabilized approach concept.

Any significant deviation from planned flight path, airspeed, or descent rate should be announced. The decision to execute a go-around is no indication of poor performance.

Note: Do not attempt to land from an unstable approach.

Recommended Elements of a Stabilized Approach

The following recommendations are consistent with criteria developed by the Flight Safety Foundation.

All approaches should be stabilized by 1,000 feet AFE in instrument meteorological conditions (IMC) and by 500 feet AFE in visual meteorological conditions (VMC). An approach is considered stabilized when all of the following criteria are met:

- the airplane is on the correct flight path
- only small changes in heading and pitch are required to maintain the correct flight path
- the airplane should be at approach speed. Deviations of +10 knots to – 5 knots are acceptable if the airspeed is trending toward approach speed
- the airplane is in the correct landing configuration
- sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted

A10.3

- thrust setting is appropriate for the airplane configuration
- all briefings and checklists have been conducted.

Specific types of approaches are stabilized if they also fulfill the following:

- ILS approaches should be flown within one dot of the glide slope and localizer, or within the expanded localizer scale
- during a circling approach, wings should be level on final when the airplane reaches 300 feet AFE.

Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

Note: An approach that becomes unstabilized below 1,000 feet AFE in IMC or below 500 feet AFE in VMC requires an immediate go-around.

These conditions should be maintained throughout the rest of the approach for it to be considered a stabilized approach. If the above criteria cannot be established and maintained until approaching the flare, initiate a go-around.

At 100 feet HAT for all visual approaches, the airplane should be positioned so the flight deck is within, and tracking to remain within, the lateral confines of the runway edges extended.

As the airplane crosses the runway threshold it should be:

- stabilized on approach airspeed to within + 10 knots until arresting descent rate at flare
- on a stabilized flight path using normal maneuvering
- positioned to make a normal landing in the touchdown zone (the first 3,000 feet or first third of the runway, whichever is less).

Initiate a go-around if the above criteria cannot be maintained.

Maneuvering (including runway changes and circling)

When maneuvering below 500 feet, be cautious of the following:

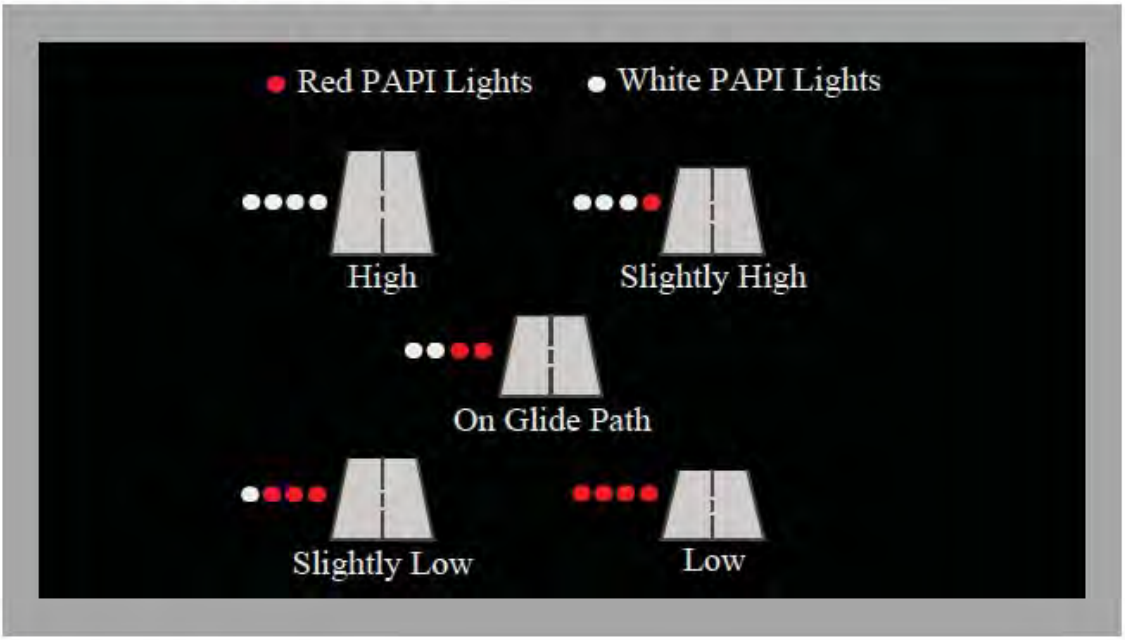
- descent rate change to acquire glide path
- lateral displacement from the runway centerline
- tailwind or crosswind components
- runway length available.

Precision Approach Path Indicator

The Precision Approach Path Indicator (PAPI) uses lights which are normally on the left side of the runway. They are similar to the VASI, but are installed in a single row of light units.

When the airplane is on a normal 3° glide path, the pilot sees two white lights on the left and two red lights on the right. The PAPI may be safely used with respect to threshold height, but may result in landing further down the runway. The PAPI is normally aligned to intersect the runway 1,000 to 1,500 feet beyond the threshold.

PAPI Landing Geometry



Landing Geometry

Visual Aim Point

During visual approaches many techniques and methods are used to ensure main landing gear touchdown at the desired point on the runway. One of the most common methods used is to aim at the desired gear touchdown point on the runway, then adjust the final approach glide path until the selected point appears stationary in relation to the airplane (the point does not move up or down in the pilot's field of view during the approach).

In first generation jet transports (e.g. B-707, DC-8), this method is acceptable because of the small difference between landing gear path and eye level path. Flare distance accounts for the small difference in paths. Gear touchdown occurs very near the visual aim point. However, in today's larger airplanes, the difference in gear path and eye-level path has increased because of the longer wheelbase and the increased flight deck height. Consequently, the main gear do not touchdown on the runway at the selected visual aim point.

Visual aim points versus gear touchdown point differences increase as glide path angle decreases as in a flat approach. For a particular visual approach, the difference between gear path and eye level path must be accounted for by the pilot.

AIRSPEED LOW

Condition: Airspeed is less than minimum maneuvering speed.

■ ■ ■ ■

Minimum Maneuver Speed

The top of the lower amber band on the airspeed display indicates the minimum maneuver speed. The functionality of the lower amber band is slightly different for flaps-down versus flaps-up operation; however, in both cases it alerts the crew that when operating at an airspeed within the amber band less than full maneuver capability exists.

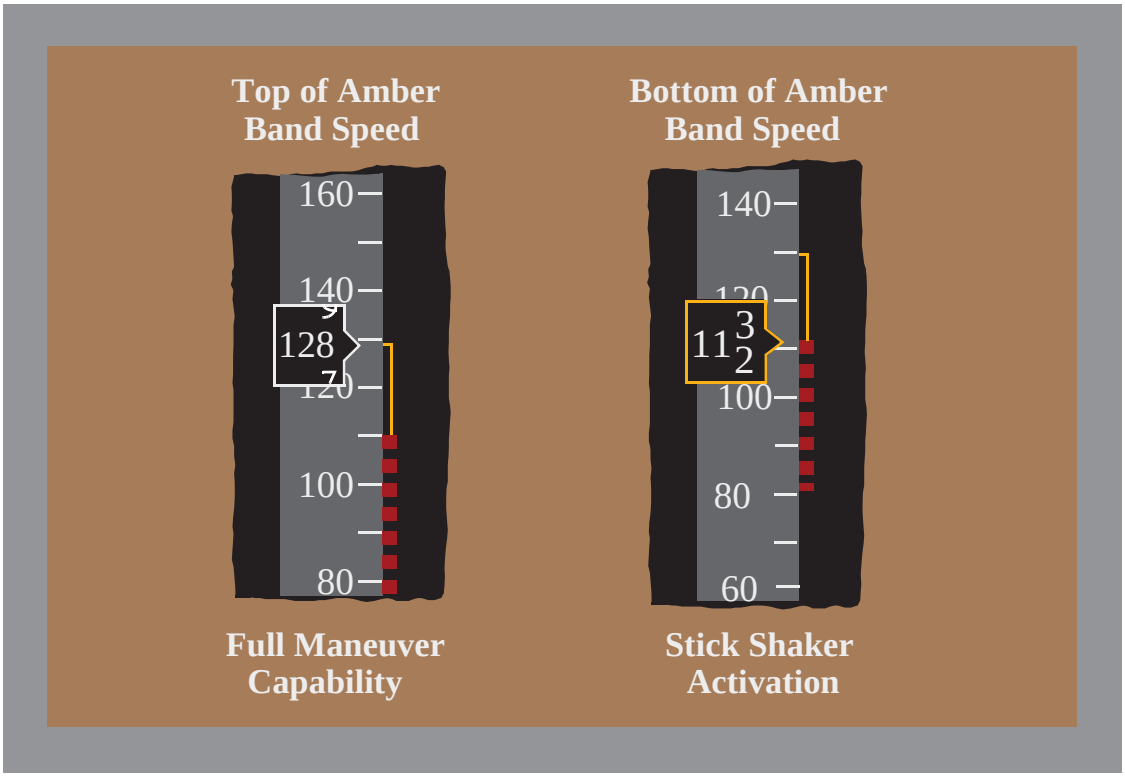
Note: During normal conditions, the target speed is always equal to or faster than the minimum maneuver speed (top of the amber band). During non-normal conditions, the target speed may be below the minimum maneuver speed.

Flaps Down Amber Band

For all flaps-down operations (any time the flaps are not full-up) the minimum maneuver speed is the slowest speed that provides full maneuver capability, 1.3g or 40° of bank (25° of bank and 15° overshoot) to stick shaker. The top of the amber band does not vary with g load.

As airspeed is decreased below the top of the amber band, maneuver capability decreases. In 1g flight, the speed in the middle of the amber band provides adequate maneuver capability or 30° of bank (15° of bank and 15° overshoot). The speed at the bottom of the amber band (top of the red and black tape) corresponds to stick shaker activation for the current g load. If the g load is increased during maneuvering, the stick shaker activation speed increases also.

Note: Stick shaker is set to activate before the actual stall. There is sufficient margin to recover from stick shaker without stalling.



Minimum maneuver speeds (displayed as the top of the lower amber band) should not be confused with flap maneuver speeds. Flap maneuver speeds are based on airplane weight, while the minimum maneuver speed is calculated using airplane angle of attack and current airspeed. These speeds provide independent means to ensure that the current airspeed provides at least full maneuver capability for terminal-area maneuvering.

Note: During normal conditions, the flap maneuver speed for the current flap detent should always be equal to or faster than the minimum maneuver speed. During some non-normal conditions, the flap maneuver speed for the current flap position may be less than the minimum maneuver speed.

Flaps Up Amber Band

For altitudes up to approximately 10,000 feet, the flaps-up amber band functions just like the flaps-down amber band described above, with the top of the amber band representing full maneuver capability. Due to increasing Mach effects between 10,000 and 20,000 feet, the maneuver capability at the top of the amber band decreases as altitude increases, but still provides at least adequate maneuver capability. Above approximately 20,000 feet, the top of the amber band shows the speed that provides 1.3g maneuver capability to low speed buffet (or an alternative approved maneuver capability as preset by maintenance).

Conditions Affecting Maneuver Margins to Stick Shaker

For a fixed weight and altitude, maneuver margin to stick shaker increases when airspeed increases. Other factors may or may not affect maneuver margin:

- Gross weight: generally maneuver margin decreases as gross weight increases. The base speed (V2 or VREF) increases with increasing weight. The speed additive is a smaller percent increase for heavier weights
- Altitude: generally maneuver margin decreases with increasing altitude for a fixed airspeed
- Temperature: the affect of a temperature change on maneuver margin is negligible

- Landing gear: a small decrease in maneuver margin may occur when the landing gear is extended. This loss is equivalent to 2 knots of airspeed or less
- Speedbrakes: maneuver margin decreases at any flap setting when speedbrakes are extended
- Engine failure during flap retraction: a small decrease in maneuver margin occurs due to the reduced lift experienced with the loss of thrust. The loss is equivalent to 4 knots of airspeed or less
- Anti-ice: the use of engine or wing anti-ice reduces flaps-up and flaps-down maneuver margin. This effect remains until the airplane lands.

Note: The term “reduced maneuver margin”, when used in reference to anti-ice systems, means that the stall warning logic adjusts stick shaker to a lower angle of attack. This results in a higher stick shaker speed and a higher minimum maneuver speed. Flap retraction and extension speeds are not affected by the use of anti-ice systems, therefore maneuver margin is reduced.